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"To the solid ground
Of nature trusts the Mind that builds for aye" —WORDSWORTH

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Serial No.	*Date of Issue*	*Pagination*
3949	July 7	1–28
3950	,, 14	29–62
3951	,, 21	63–90
3952	,, 28	91–124
3953	August 4	125–152
3954	,, 11	153–186
3955	,, 18	187–214
3956	,, 25	215–248
3957	September 1	249–276
3958	,, 8	277–310
3959	,, 15	311–344
3960	,, 22	345–372
3961	,, 29	373–400
3962	October 6	401–428
3963	,, 13	429–456
3964	,, 20	457–484
3965	,, 27	485–512
3966	November 3	513–546
3967	,, 10	547–580
3968	,, 17	581–608
3969	,, 24	609–642
3970	December 1	643–670
3971	,, 8	671–698
3972	,, 15	699–726
3973	,, 22	727–760
3974	,, 29	761–788

R 286

RP

INDEX

NAME INDEX

of Sciences of the U S.S.R. : Conference on Viscosity of
uids and Colloidal Solutions, 147
. Anniversary Celebrations, 221
ction of Academician Sergei Vavilov as president, 230
stronomical Institute of the) . Ephemerides for the Determination of Time Corrections by Equal Altitudes (Zinger's Method) for
1944, 16
uaire astronomique de l'URSS pour l'an 1944, 17
ry Food Factors Committee (Vitamin A Sub-Committee of the) ·
periment on the Human Requirement of Vitamin A and of
ane, 11
J. K. : Surface Chemistry in the U.S.S R., 284
Obituary by Dr. A T. Hopwood, 470
Roger : Awarded the Davy Medal of the Royal Society, 596,
C. : Time Factor in Surface Tension Measurement, 600
Retirement of Dr. C. F. Goodeve from the post of deputy
ller for research and development, 472
ent of A P. Rowe as deputy controller for research and
pment, 472
E. D. Physiology in the U S S R., 222
Magendie (1783–1855), *review*, 316
College of · Appointment of the Board of Governors, 200
ment of E. F Relf as principal, 623
N. · Elected to an Imperial Chemical Industries Fellowship at
ridge, 17
Bureaux, Imperial . Joint Publication No. 7 on *Imperata*
ylindrica, 342
ultural Economics Research Institute, Oxford : Retirement of Dr. C S. Orwin, 500
Appointment of Prof. A. W Ashby as director, 624
icultural Research Council . Appointment of Prof R. G. White and Dr. C H Waddington to its scientific staff, 231
culture and Fisheries, Ministry of : Advisory Leaflet No. 315 on Weed Control in Cereals, 330
nt of Dr. E. S. Russell from the post of director of fishery
ations, 687
ent of R R. Enfield as chief economic adviser, 687
nent of D. A. E. Harkness as principal assistant secretary in
of the Economics and Statistics Division, 687
Appointment of Dr. H R. Hulme as scientific adviser, 745
blishment, Royal Pamphlet on Aeronautical Training, 78
kle, Dr J., and) : Flow of Water through Very Narrow
als and Attempts to Measure Thermomechanical Effects in
, 367
and others (edited by) · Essays in Anthropology Presented
hadur Sarat Chandra Roy, *review* by Prof. J. H. Hutton, 66
of F. . *Death* of, 596
ield-Marshal the Hon. Sir Harold . Elected an honorary
of the Institution of Civil Engineers, 598
of. W H. · Presidential Address to Section II of the Royal
of Canada, 271
lannes . A New Theory of the Origin of the Planets, 378
A. H : A Simple Trap for Catching Fleas, 501
entific Research Institute of Plant Industry of the U.S.S.R. ·
n to Leningrad, 745
Frank . Production of Difference Tones, 84
and others . Use of Carbon Dioxide in Fruit Storage and
rt, 178
cival · Lognormal Distributions, 746
· Colorimetric Analysis, *review* by A L. Bacharach, 434
lemy of Tropical Medicine · Theobald Smith Gold Medal
to Dr. C M. Wenyon, 473
nical Society : Appointment of Dr. Cornelia T. Snell as
an of the New York Section, 230
armaceutical Manufacturers' Association Award of Distinction
nted to the National Research Council of the United States
nal Academy of Sciences, 575
ilosophical Society and the U S. National Academy of Sciences
meeting on Atomic Energy and its Implications, 687
J. (Kent-Jones, Dr D. W., and) : Bread in Jersey during
an Occupation, 336
r John : Research in relation to Reconstruction, 660
and Reconstruction, 711, 733
Dr. H. B . Mammary Tumours in Mice, 787
f. E. N. da C. : Effect of Alpha-Ray Bombardment on Glide
al *Single Crystals*, 113
orary Physics in the U.S S R., 223
F. : Scientific Film Needs in Technical Training, 426
and the Burmah Oil Companies · Offer of £750 a year to
eological Society of London to defray the costs of an instruc-
al tour for students, 533
ehaviour, Institute for the Study of · Election of officers, 566
Production, British Society of : Discussion on Pig Production, 454
, Prof. H. E. : *Obituary* by Dr. Sarah Barnes, 328
opological Institute, Royal, and the Social Psychology Section of the British Psychological Society · Discussion on the Scapegoat in Modern Europe, 380
roff, Prof George : Time *Dependence of Interfacial* Tension and
Density In Solutions, 301

Appleton, Sir Edward . Departure of Long-Wave Solar Radiation from Black-Body Intensity, 534
  Elected an honorary member of the Institution of Civil Engineers, 598
Archbold, H. K Some Factors concerned in the Process of Starch Storage in the Barley Grain, 70
Architects (Naval), Institution of Appointment of Capt Arthur Dyce Duckworth as secretary, 502
Arden, R. W Awarded a fourth prize by the Institute of Welding, 473
Aristotelian Society : Proceedings of the, New Series, Vol. 44, Session 1943–1944, *review* by Prof. A. D. Ritchie, 33
Aristotle's Criticism of Plato and the Academy (Harold Cherniss), Vol. 1, *review* by Prof. A. E. Taylor, 647
Armstrong, Dr. E F. . *Obituary* of Sir David Milne-Watson, 499
  The Royal College of Chemistry, 524
  A United Nations Educational and Cultural Organisation—Introduction, 553
  The Allied Plan for Education, 708
  Death of, 742
Arthur, D. R : Hatching of the Egg of *Ixodes ricinus* L., 538
Arts, Royal Society of : Prize and Award under the Thomas Gray Memorial Trust, 17
Aschner, Dr. M , and others : Production of Extracellular Starch in Cultures of Capsulated Yeasts, 295
Ashby, Prof. A. W. · Appointed director of the Agricultural Economics Research Institute, Oxford, 624
Ashcroft, Miss Lucy : *Death* of, 415
Ashworth, Dr. J. R · Behaviour of Ultra-Violet and Daylight Rays in the Solar Cycle, 115
Asiatic Society of Bengal, Royal : Conference on Indology and Oriental Culture, 687
ASLIB : Conference on Microfilm and other Means of Documentary Reproduction, 24
  Report of the Proceedings of the Nineteenth Conference, 108
  Twentieth Annual Conference, 232, 605
Association of Applied Biologists · Report on the Recruitment and Training of Plant Pathologists in Great Britain, 724
Association for Planning and Regional Reconstruction : Development of its Information Service, 775
Association of Scientific Workers : Appointment of Roy Innes as general secretary, 331
  Discussion on the Inter-relations between the Natural and Social Sciences, 652
  (Leeds Branch) : Conference on Science and Education, 56
Association of Special Libraries and Information Bureaux · Conference on Microfilm and other Means of Documentary Reproduction, 24
  Report of the Proceedings of the Nineteenth Conference, 108
  Twentieth Annual Conference, 232, 605
Association of University Professors and Lecturers of the Allied Countries in Great Britain : Some Comparisons between Universities (Proceedings of the Second Education conference), 183
Association of University Teachers · Second Report on University Developments, 311
Astbury, Dr. W. T. : Structure of Biological Fibres and the Problem of Muscle, 89
  X-Ray Adventures among the Proteins and other Molecular Giants, 427
  Appointed to the chair of biomolecular structure in the University of Leeds, 501, 531 ; work of, 531
Aston, Dr. F. W. : *Death* of, 657
Asundi, Prof. R. K., and Padhye, M. R. : Near Ultra-Violet Emission Bands of Benzene, 368
Asundi, Prof. R. K , and Venkateswarlu, P. : Emission Bands of the Fluctuation Type in the Spectrum of Iodine, 452
Atkins, Dr. W R. G. · Autotrophic Flagellates as the Major Constituent of the Oceanic Phytoplankton, 446
  Conditions for the Vernal Increase in the Phytoplankton and a Supposed Lag in the Process, 599
Atzenweiler, L. F. . Pre-War Production and Distribution of Narcotic Drugs and their Raw Materials, 361
Augustinsson, Dr K.-B · Choline Esterases, 303
Austin, H. B · The Merino, *review* by Dr. J E. Nichols, 251
Austin, Prof. James M (Haurwitz, Prof Bernhard, and) Climatology, *review* by Prof D. Brunt, 157
Australian Council for Scientific and Industrial Research : Retirement of Gerald Lightfoot from the secretaryship, 444
  Appointment of G A Cook as secretary, 444
Avery, Dr. O. T . Awarded the Copley Medal of the Royal Society, 596, 694
Aykroyd, Dr W. R. : Organisation of Scientific Research in the British Commonwealth, 758
Azerbaijan Academy of Sciences : Foundation of the, 44

BABBITT, Dr J. D. : Hysteresis in the Adsorption of Water Vapour by Wheat, 265
Babcock and Wilcox, Ltd · Grant of £750 to the University of Leeds for equipment in the Coal Gas and Fuel Industries Department, 502
Bacharach, A. L. : Colour for Analysts, *review*, 434
Bacteriologists (Agricultural), Society of : Name changed to the Society for Applied Bacteriology, 481
  Papers at the Summer Conference, 481

Baddiley, Dr. J. : Elected to an Imperial Chemical Industries Fellowship at Cambridge, 17
Bailey, C R. · Degree of D.Sc. of the University of London conferred on, 108
Bailey, J E. C. : Elected president of the Scientific Instrument Manufacturers' Association of Great Britain, 202
Bailey, Dr. K. · Elected to an Imperial Chemical Industries Fellowship at Cambridge, 17
  Proteins, Amino-Acids and Peptides, *review*, 405
Bailly, J., and Decrop, G. : A propos d'un procédé d'exploration simple de l'état fonctionnel du Foie, 395
Bairstow, Prof. L. . Retirement from the Zaharoff chair of aeronautics in the University of London, 165 , work of, 165
Baker, A L. L. : Appointed to the University of London chair of concrete technology at the Imperial College of Science and Technology, 45
Baker, Frank Collins : The Molluscan Family Planorbidæ, *review* by F. Martin Duncan, 765
Baker, Dr. H. G. · Late Flowering of Horse-Chestnut, 721
Baker, John R. : Science and the Planned State, *review*, 614
Baker, Mrs. Kathleen M. : Use of Hydrochloric Acid for Softening Algal Tissues for Microtome Sections, 479
Baker, Prof. W. : Natural Organic Colouring Matters, *review*, 552
Balint, Edna M., and others : An Introduction to Child Guidance, *review* by Dr Alan Maberly, 157
Balliol, The Master of : The Good and the Clever, 744
Banerjee, B. K., and others : X-Ray Study of the Solution of Alkali Halides in Borax and B_2O_3 Glass Systems, 423
Bangham, Dr. D. H. : The Corrosion of Metals, 435
Barac, G., and others : Les états de carence en Belgique pendant l'occupation Allemande 1940–1944, *review* by Major J Marshall, 551
Barber, D. R. : The 'Green Flash' at Sunset with a near 'Horizon', 146
Barclay-Smith, Prof. E. : *Death* of, 42 ; *obituary* by Prof. A. J. E. Cave, 136
Barclay-Smith, Phyllis Garden Birds, *review*, 34
Barducci, Prof. Teodoro Boza, and others : Control of Internal Boll Rot of the Cotton Plant, caused by Insect Punctures (*Dysdercus* sp.), through Selection of Resistant Strains, 235
Barker, Sir Ernest · Some Comparisons between Universities, 183
Barlow, Dr. H E. M. . Title of University of London professor of electrical engineering conferred on, 566
Barnard, G. A. : A New Test for 2 × 2 Tables, 177, 783
  Economy in Sampling, 208
Barnes, R Bowling, and others : Infra-red Spectroscopy, *review* by Dr. H W. Thompson, 65
Barnes, Dr. Sarah *Obituary* of Prof. H. E. Annett, 328
Barnes, T. W. · Accumulation of Sugars in Barley Seedlings on Very Acid Soil, 692
Barnes, W. H. F. : Appointed to the chair of philosophy in the Durham Division of the University of Durham, 202
Barry, Vincent C., and McNally, Dr. P. A. Inhibitory Action of Dialkyl Succinic Acid Derivatives on the Growth *in vitro* of Acid-fast Bacteria, 48
Bartlett, Prof. F. C. : Appointed a member of the Industrial Health Research Board of the Medical Research Council, 566
Basch, Dr Antonin : The Danube Basin and the German Economic Sphere, *review*, 551
Baskett, Prof. R. G. : Pig Production, 454
Bate-Smith, Dr. E. C., and Bendall, J. R. : Heat Coagulation of Muscle Proteins, 632
Bateman, Dr. L. C. : Photochemical Breakdown of Rubber, 9
Bates, Dr. William H. The Bates Method for Good Sight without Glasses, *review*, 281
Bathe, Greville : The Onandaga Salt Works of the New York State, 1646—1846, 759
Bauchwitz, F. K., and Shoenberg, D. : A New Interference Effect, 142
Bayer, Dr. Augustus : Executed by the Germans in 1942, 416
B.B.C. : Programmes entitled 'Science Magazine', 140
Beakbane, Dr. A. Beryl, and Thompson, Dr Eleanor C. Abnormal Lignification in the Wood of some Apple Trees, 145 , *erratum*, 202
Beale, Dr. G H. · Recent Biological Work in Finland, 357
Beattie, A. G. : Appointed director of agriculture, Nigeria, 445
Beck, Stephan . Spontaneous Regression of Histologically Malignant Tumours Induced in Rabbits by 9 : 10-Dimethyl-1 . 2-Benzanthracene, 238
Bedford College : Appointment of D. W. Harding to the University of London chair of psychology, 108
Bell, Geoffrey : The Film in Science, 426
Bell Telephone Laboratories : New Buildings of, 274
Bellamy, C. V. . Science in Adult Education, 57
Bellamy, Colonel R. G. . Resignation from the lectureship in mechanical engineering in the University of Sheffield, 473
Bendall, J. R. (Bate-Smith, Dr. E. C , and) · Heat Coagulation of Muscle Proteins, 632
Benesch, Dr R. : Biochemical Aspects of Mental Disorder, 103
Benfield, H. : The Place of Science in Primary Schools, 56
Benford, G. A., and others · Univalent Electron Transfers in Aromatic Nitration ?, 688
Bengough, Percy . Appointed a member of the National Research Council of Canada, 416
Benham, Dr. F. C. . Appointed to the University of London chair of commerce at the London School of Economics, 108
Benham, W. E. : A New Occurrence of the Electronic Phase Velocity, 204
Bentwich, Prof. Norman : The Educational and Cultural Organisation of the United Nations, 445
Berenblum, Dr. I. : 3 : 4-Benzpyrene from Coal Tar, 601
Berg, Dr. W. F. : New Basic Concepts in Electrocardiography—The Ventricular Gradient, 590
Bergel, Dr. F. : The Vitamin B_2 Complex, 87
Bergstrom, Sune : Autoxidation of Linoleic Acid, 717
Bernacca, J P. : Appointed entomologist, Uganda, 687
Bernal, Prof. J. D. · Microfilm and other Means of Documentary Reproduction, 26
  A United Nations Educational and Cultural Organisation—A Permanent International Scientific Commission, 557
  Awarded the Royal Medal of the Royal Society, 596, 694
  Information Service as an Essential in the Progress of Science, 605
  The Inter-relations between the Natural and Social Sciences, 652
  Lessons of the War for Scientists, 659
Berry, P. A , and Macbeth, Prof. A Killen : A Tetrabromide of β-Ph landrene, 175
Berthelot, R. : Cosmic Rays, 544
Betekhtin, A. G : Manganese Deposits of the U.S S R., 87
Betts, Prof. Edwin Morris (annotated by) : Thomas Jefferson's Gard Book, 1766–1824, with Relevant Extracts from his other Writing *review* by Dr. E. J Salisbury, 128
Bezssonoff, Dr. N., and Leroux, Dr. Helène Vitamin C Peroxidas Activity, 474
Bhagavantam, Prof. S., and Bhimasenachar, J. : Shear Modes in Nor Piezo-Electric Crystal Plates, 23
Bhatia, A. B. (Krishnan, Prof. K. S., and) . Electrical Resistance of Liqu Metals, 503
Bhattacharjee, S K. (Saha, J C , and) · Artificial Production of Ergot the Tropical Plains of Bengal, 363
Bhimasenachar, J (Bhagavantam, Prof S., and) : Shear Modes in Non Piezo-Electric Crystal Plates, 23
Bibby, Cyril · Sex Education—Aims, Possibilities and Plans, 412, 438
Bielschowsky, F , and Green, Prof. H. N. : An Induced Carcinoma in th Fowl, 780
Bielschowsky, Marian, and Green, Prof. H N. · Synthesis of Adenosin Triphosphate by an Enzyme System from Ischæmic Muscle, 117
Bilibin, Y. A : Post-Jurassic Intrusions of the Aldan Region, Easter Siberia, 178
Biochemical Society and the Nutrition Society · Joint meeting on th Vitamin B_2 Complex, 86
Biological Council Formation of a, 713
Biologists (Applied), Association of . Report on the Recruitment an Training of Plant Pathologists in Great Britain, 724
Bishop, F. P. . The Economics of Advertising, *review*, 765
Bishui, B. M. (Sirkar, Dr. S. C , and) : Fluorescence of Dipropyl Ketone at Low Temperatures, 333
Bissett, C. B. . Appointed deputy director of the Geological Survey Uganda, 687
Bittner, Dr. J. J. Mammary Tumours in Mice, 787
Black, Archibald N. : Appointed Donald Pollock reader in engineering science in the University of Oxford, 417
Blackett, Prof P. M. S . Cosmic Rays, 543
  Obituary of Prof. E. J. Williams, 655
Blackfan, Dr. Kenneth D , and Diamond, Dr Louis K : Atlas of the Blood in Children, *review* by Prof. Thos. B Davie, 192
Blackman, G E. · Appointed Sibthorpian professor of rural economy at the University of Oxford, 262 ; work of, 262
Blackwell, Miss E. M. . Late Flowering of Horse-Chestnut, 721
Blair, Dr. G. W. Scott Viscosity of Liquids and Colloidal Solutions, 147
Blake, Dr. Francis G. : Awarded the United States Typhus Commission Medal, 445
Blaschko, Dr. H , and Duthie, Ruth · Action of Mepacrine on Diamine Oxidase, 113
Bloch, Dr A. . Electromechanical Analogies, 151
Block, Dr. Richard J., and Bolling, Diana · The Amino Acid Composition of Proteins and Foods, *review*, 33
Bloom, H. (Heymann, Dr. E., and) . Activation Energy of Ionic Migration in Molten Salts, 479
Bloxham, J L. (Parkinson, Dr. D , and) The Behaviour of Natural Rubber and GR-S under Repeated Stress Cycles, 11
Blyton, Enid : Faiths of Many Lands (E. Royston Pike), *review*, 34
Boardman, Philip . Patrick Geddes, Maker of the Future, *review* by R. Brightman, 612 , *erratum*, 687
Boerker, Richard H. D. . Behold our Green Mansions, *review* by Prof. F. J. Lewis, 584
Bolin, Rolf L. · Marine Cottid Fishes of California, 395
Bolivar y Urrutia, Don Ignacio : *Obituary* by Dr. B. P. Uvarov, 74
Bolland, J L. (Orr, Dr. W. J C., and) · Thermal Breakdown of Rubber, 9
Bolling, Diana (Block, Dr. Richard J., and) . The Amino Acid Composition of Proteins and Foods, *review*, 33
Boorman, K. E., and others : Enhancement of the Action of Immune Hæm-Agglutinins by Human Serum, 663
Booth, A. D. . Accuracy of Atomic Co-ordinates Derived from Fourier Systems, 51
Borg, Prof. John . *Obituary* by W. B. Turrill, 14
Born, Prof. Max Theoretical Physics in the U S S.R , 325
  Dublin Colloquium, 1945, 704
  Quantum Electrodynamics, 705
  Some Problems of the Theory of Crystals, 705
Born, Prof. Max, and Bradburn, Mary The Raman Effect in Rocksalt, 567
Born, Prof Max, and others : A Photo-Electric Fourier Transformer, 756
Borradaile, Dr. L A *Obituary* by Prof. J. Stanley Gardiner, 622
Bose, Prof. S. R. . Anti-bacterial Action of 'Polyporin' against Typhoid, Cholera, Dysentery and *B. coli*, 171
Bose Research Institute, Calcutta : Annual Report for 1943–44, 696 , Annual Report for 1944–45, 697
Botanic Gardens, Royal, Kew Appointment of Dr. Debabrata Chatterji as assistant for India, 444
Bourne, L. B Hexachloro*cyclo*hexane as an *Insecticide*, 85
Bouvier, Prof. Eugène-Louis *Obituary* by Dr. E. Hindle, 42
Bowden, Dr. F. P., and others · Lubrication of Metal Surfaces by Fatty Acids, 97
Boyazoglu, Dr. A. J. . Elected a fellow of the Royal Society of South Africa, 687
Boyd, Dr. A E. W , and others : Control of Dry Rot of Seed Potatoes by Dusting, 394
Boyd, Prof. J. D , and others · Human Embryology, *review* by Dr. D. V. Davies, 315
Boyland, Dr. E. : Mammary Cancer in Mice, 787
Brabazon of Tara, Lord : Freedom for Scientific Research, 746
Bradburn, Mary (Born, Prof Max, and) : The Raman Effect in Rocksalt, 567
Bradford Dyers' Association, Ltd. . Grant of £1,500 a year for two years to the University of Leeds for the Institution of two research fellowships, 502
Bradley, C. B. · Science and Education, 57
Braestrup, F. W. : Progressive Clines, 337
Bragg, Sir Lawrence : Lectures at the Sorbonne in Paris, 45
  To visit Portugal under the auspices of the British Council, 598
Bragg, Sir Lawrence, and Stokes, A. R · X-Ray Analysis with the Aid of the 'Fly's Eye', 332

Brain, E. Dorothy · Growth Inhibition in Pea Seedlings, 397
Braithwaite, Rachel R., and Clayton, Evelyn B. : A British Freshwater Nemertine, 237
Brakier-Zelkowiecz, T., and others : Les états de carence en Belgique pendant l'occupation Allemande 1940–1944, *review* by Major J. Marshall, 551
Bratley, C. O., and others : Use of Carbon Dioxide in Fruit Storage and Transport, 178
Brenchley, Dr. W. E. : *Obituary* of Dr J. Davidson, 359
Brend, Dr. William A. : Foundations of Human Conflicts, *review* by Dr. William Brown, 314
Brenner, S., and others : Porphyrin Fluorescence in the Livers of Pellagrins in relation to Ultra-Violet Light, 689
Brian, Dr. P. W., and McGowan, J. C. : Viridin, a Highly Fungistatic Substance produced by *Trichoderma viride*, 144
Bridge, J. F. : *Obituary* of Sir William H. Ellis, 290
Brightman, R. : Management of a Special Library, *review*, 406
  Problems of the Modern University, *review*, 432
  Patrick Geddes, *review*, 612 ; *erratum*, 687
Brimble, L. J. F. : Return from a tour of India and Burma, 291
Brindle, H. : Origin and Development of Pharmaceutical Chemistry, 138
Brindley, Dr. G. W ,,and Robinson, Keith Structure of Kaolinite, 661
British Association : Re-opening of the Charles Darwin memorial rooms at Down House, 533
British Association of Chemists : Appointment of J. Stewart Cook as organising secretary, 362
  (London Section) · Open meeting on Social Security for Chemists, 331
British Association for Labour Legislation : The New I.L.O., 231
British Bryological Society : First meeting since June 1939, 626 , *erratum*, 777
British Cotton Industry Research Association . Fellowships, 200, 686
British Council . British Medical Exhibition at the Sao Jose Hospital in Lisbon, 45
  Appointment of Dr. A E. Morgan as educational director, 77
  Establishment of an Argentine-British Medical Centre in Buenos Aires, 107
  Annual Report, 122
  Chinese Visitors to Britain as guests of the, 201
British Ecological Society : Memorandum on the Establishment of an Aerial Unit for Scientific Work, 2
British Grassland Society : First meeting of the, 78
British Industries, Federation of : Appointment of B. J. A. Bard as head of the F.B.I. Research Secretariat and secretary of the F B.I. Industrial Research Committee, 77
British Iron and Steel Research Association : Formation of the, 138
  Appointment of Dr. C. F. Goodeve as director, 138, 472
British, Medical Association (Nutritional Committee of the Jamaica Branch) : Report on Nutrition and Agriculture in Jamaica (Dr. W. E. McCulloch and colleagues), 288
British Museum (Natural History) : Appointment of N. B. Kinnear as keeper in the Department of Zoology, 17
  Retirement of M. A. C. Hinton as keeper of the Department of Zoology, 43
British Psychological Society (Social Psychology Section) and the Royal Anthropological Institute : Discussion on the Scapegoat in Modern Europe, 380
British Rheologists' Club : Conference on Strength of Materials, 306
  Fifth Annual General Meeting, 745
  Re-election of Prof. E. N da C. Andrade as president, 745
British Rheologists' Club, and the Manchester Section of the Oil and Colour Chemists' Association · Discussion on the General Rheological Properties of Suspensions, 745
British Schering Research Institute : Appointment of Dr. J. S. H. Davies as director of research, 626
British Social Hygiene Council and the Town and Country Planning Association : Conference on the Needs and Problems of the Family, 777
British Society of Animal Production : Discussion on Pig Production, 454
Brodetsky, Prof. S. : Science and the University, 57
Bronikovsky, N ·(Graham, H. W., and) : The Genus *Ceratium* in the Pacific and North Atlantic Oceans, 181
Brooks, Dr C. E. P. : The 'Green Flash' at Sunset with a Near Horizon, 368
Brosset, Cyrill : Formation of an Addition Compound of Calcium Silicate and Sodium Fluoride, 451
Brotherton, Charles · Gift of £55,000 to the University of Leeds for a new chemical engineering laboratory, 659
Brown, F. : Awarded a Shirley Fellowship by the British Cotton Industry Research Association, 686
Brown, F., and others : Application of New Methods of End-Group Determination to Structural Problems in the Polysaccharides, 785
Brown, Robert · Degree of D.Sc. in the University of London conferred on, 533
Brown, R. L. : Strength of Materials, 307
Brown, R. L., and Hawksley, P. G. W. : Packing of Regular (Spherical) and Irregular Particles, 421
Brown, Prof. R. N. Rudmose : Retirement from the chair of geography at the University of Sheffield, 106 ; work of, 106
  United States Antarctic Discoveries, 399
Brown, Dr. William : The Inferiority Complex and the Paranoid Tendency, with a Brief Reference to Nazi Psychology, 259
  Psychology of War, *review*, 314
Bruce, Capt. Maurice : Poverty and Politics in Central Europe, *review*, 551
Brull, Lucien, and others· Les états de carence en Belgique pendant l'occupation Allemande 1940–1945, *review* by Major J. Marshall, 551
Brunt, Prof. D : Climatology for Meteorologists, *review*, 157
  The Elements Rage, *review*, 703
Bryant, L. R., and Gardner, R : Phosphorus Deficiency of Fruit Trees, 178
Bryological Society, British : First meeting since June 1939, 626 ; *erratum*, 777
Buchanan, Dr. G. V. · *Obituary* by Prof. F. Wood Jones, 385
Bucher, Dr. T. · Message to Prof H. A. Krebs concerning Prof. Otto Warburg, 714
Buck, Peter H (Te Rangi Hiroa) : Arts and Crafts of the Cook Islands, 61
Buist, L M., and Welding, G. N. : Use and Misuse of Accelerated Ageing Tests, 10
Bulian, Walter, and Fahrenhorst, Eberhard : Metallography of Magnesium and its Alloys, translated by the Technical Staffs of F. A. Hughes and Co., Ltd., and Magnesium Elektron, Ltd , *review*, 614
Bullard, Dr. E. C. : Thermal History of the Earth, 35
Bullough, Dr W. S. : Demonstration of Mitosis in Animal Cells, 574
Bunge, Mario : Nietzsche and Science, 263
  Neutron-Proton Scattering at 8 8 and 13 MeV., 301
Bunton, C. A., and others · Univalent Electron Transfers in Aromatic Nitration?, 688
Burbury, W. Mary, and others : An Introduction to Child Guidance, *review* by Dr. Alan Maberly, 157
Burkitt, M. C. : Iron Age Finds from Anglesey, 309
  The Stone Age in East Africa, 371
  Excavations at Hyrax Hill, Nakuru, Kenya Colony, 722
Burmah and Anglo-Iranian Oil Companies : Offer of £750 a year to the Geological Society of London to defray the costs of an instructional tour for students, 533
Burman, U. R. (Sen, N. R., and) : Nuclear Energy Generation in the Sun, 305
Burnett, G. M., and Melville, Prof. H. W. : Propagation and Termination Coefficients for Vinyl Acetate Photopolymerization, 661
Burra, J. A. N. : Appointed assistant conservator of forests, Palestine, 697
Burrell, A. B. : Biennial Bearing of Apple Trees, 304
Burt, Prof. Cyril : Use of Stereographic Projection for Statistical Problems, 338
  Obituary of Prof. C. E. Spearman, 740
Bush, Dr. Vannevar : Science, the Endless Frontier, 125, 130
  Awarded the Marcellus Hartley (Public Welfare) Medal for 1945 of the United States National Academy of Sciences, 575
Busvine, J. R. : Insecticidal Action of D.D.T., 169
Butler, Dr. J. A. V. : Adsorption of Enzymes on Solid Nucleic Acid, 781
Butlin, K. R (Thaysen, Dr. A C., and) : Inhibition of the Development of *Fusarium oxysporum cubense* by a Growth Substance produced by Meredith's Actinomycetes, 781
Buttle, Dr. G. A. H. . Appointed to the University of London chair of pharmacology at the College of the Pharmaceutical Society, 566, 624
Buu-Hoï, Dr. Ng. Ph. : Fatty Constituents of Tubercle Bacilli as Growth-Inhibitors of the same Bacilli, 392
Buxton, Prof. P. A.· Appointed a member of the Medical Research Council, 362
Buzzard, Sir Edward Farquhar . *Death* of, 774
Buzzati-Traverso, Dr. A. · Scientific Affairs in Italy, 576
Byerly, Perry : Seismology, *review* by E. Tillotson, 95
Byers, Robert D. (Godsil, H. C., and) : A Systematic Study of the Pacific Tunas, 184

CALEY, E. R , and others : 'Fissibactericidal' Nature of Penicillin Action, 49
Callendar, G. S , and Egerton, Sir Alfred : The 1939 Callendar Steam Tables, second edition, *review* by Dr. H. Heywood, 462
Cameron, Prof. A T : Recent Advances in Endocrinology, fifth edition, *review*, 34
Campbell, A. C. : Good Farm Accounting, *review*, 764
Campbell, G. A , and others : Efficacy of D D.T. in Soap, 749
Campbell, H., and Herington, E. F. G. : Interaction of Aluminium Halides with the Xylenes, 389
Campbell, Dr John R. . Appointed lecturer in fuels at the Royal Technical College, Glasgow, 687
Canada, National Research Council of : Awards for Postgraduate Training, 201
  Appointment of members, 416
  Annual Report for 1943–44, 500
  Post-War Planning for Scientific Research, 500
Cancer Institute, National : To compile and publish all data relative to Cancer Therapy, 387
  (Members of the Staff of the) : Mammary Tumours in Mice, 787
Cancer Research Fund, Imperial : Forty-second Annual Report for 1944–1945, 343
Cannon, C. G., and Sutherland, Dr. G. B. B. M · Infra-Red Spectra of Coals, 240
Cannon, Prof W. B. : *Death* of, 443
Caputto, Ranwel, and Dixon, Dr. Malcolm : Crystallization and Identity of the Triose and Triosephosphate Dehydrogenases of Muscle, 630
Carnegie Corporation of New York : Annual Report for 1944, 212
Carnegie Institution of Washington : Annual Report for 1943–44, 453
Carnegie Trust for the Universities of Scotland : Forty-third Annual Report, 182
Carnegie United Kingdom Trust · Thirty-first Annual Report, 329
Carr, J. G. . Mechanism of the Feulgen Reaction, 143
Carstairs, C. Y. : Organisation of Scientific Research in the British Commonwealth, 758
Carter, E J. · Microfilm and other Means of Documentary Reproduction, 26
  The Planning and Equipment of Research Libraries and Information Bureaux, 605, 606
Carter, G. W. : The Simple Calculation of Electrical Transients, *review* by Dr. L. E. C. Hughes, 6
Case, Dr. R. A. M. : Inverse Binomial Sampling, 115
Cass Technical Institute, London : Retirement of George Patchin from the principalship, 445
  Appointment of Dr. A. M. Ward to the principalship, 445
Castle, Lieut.-Colonel J. P. : Copies of *Nature* for Service Men, 140
Catcheside, D. G. (Danielli, Dr. J. F., and) : Phosphatase on Chromosomes, 294
Cave, Prof A. J. E. : *Obituary* of Prof. E. Barclay-Smith, 136
Central Advisory Council for Education in H.M. Forces . Report for 1944–1945, 107
Chain, Dr E. B. : Nobel Prize for Medicine for 1945 awarded jointly to Sir Alexander Fleming, Sir Howard Florey and, 533, 564
Challinor, Dr. S. W , and McNaughtan, Mrs. Jean : Concentration of Solutions of Salts of Penicillin, 602
Chalmers, Dr B., and Jones, E. R W. : Application of Statistical Methods to Mechanical Test Results, 307
Chalmers, G. H. : Bacteria in relation to the Milk Supply, third edition, *review*, 406

Chapman, Dennis : The Inter-relations between the Natural and Social Sciences, 653
Chapman, Dr. Frank M. : *Death* of, 623 ; *obituary* by N. B. Kinnear, 741
Chapman, Prof. Sydney : The Earth's Magnetism, 45
Chapman, Dr. V. J. : Air Photography in the Far East, 604
Chapman, Dr. V. J. and others : Need for Development of Tropical Ecological Studies, 627
Chatterji, Dr. Debabrata . Appointed assistant for India at the Royal Botanic Gardens, Kew, 444 ; work of, 444
Chattopadhayay, K. P., and others (edited by) : Essays in Anthropology Presented to Rai Bahadur Sarat Chandra Roy, *review* by Prof. J. H. Hutton, 66
Chemical Industry, Society of : Annual Reports on the Progress of Applied Chemistry, Vol. 28, 1943, *review*, 281
  (Chemical Engineering Group), the Institution of Chemical Engineers, and the Institute of Physics : Joint Conference on Instruments for the Automatic Controlling and Recording of Chemical and other Processes, 45, 723
Chemical Research Laboratory, Teddington . Appointment of Prof. R. P. Linstead as director, 415
Chemical Society : Liversidge Lecture (Prof. E. K. Rideal), 468
  Tilden Lecture to be delivered by Prof E. D. Hughes, 777
Chemistry : The Royal College of (Dr. E. Frankland Armstrong), 524
Chemists, British Association of : Appointment of J. Stewart Cook as organising secretary, 362
  (London Section) · Open meeting on Social Security for Chemists, 331
Chen, S. L., Cheng, B. L., and Cheng, W. K · An Antibiotic Substance in the Chinese Water-chestnut, *Eleocharis tuberosa*, 234
Cherniss, Harold : Aristotle's Criticism of Plato and the Academy, Vol. I, *review* by Prof. A. E. Taylor, 647
Cheshunt Experimental Station : Twenty-ninth Annual Report of the, 88
Chichester, Francis : Sun Compass, *review*, 318
Childe, Prof. V. Gordon : Archæology and Anthropology in the U.S.S.R., 224
Chilton, L. V. : Microfilm and other Means of Documentary Reproduction, 24
Chinese Chemical Society : Volumes of the *Journal* for the years 1941–44, 511
Chu, H. C. (Tsien, L. C., and) · Harmonics in the Piezo-Electric Oscillation of a Quartz Crystal, 424
City and Guilds College—Engineering at the Imperial College (Prof. E. F. D. Witchell), 650
Clark, Prof Hubert Lyman : Palolo Worms, 508
Clark, H. W. (the late) : Awarded a third prize by the Institute of Welding, 473
Clark, L. M., and Haslam, J. : Occurrence of Boron Phosphate in Fireside Deposit from an Economizer, 302
Clark, Prof. W. E. Le Gros : Regeneration of Mammalian Striated Muscle, 109
Clark-Kennedy, A. E : The Art of Medicine in relation to the Progress of Thought, *review* by Dr. G. Lapage, 488
Clarke, —. . The Corrosion of Metals, 438
Clarke, Sir Fred : Some Comparisons between Universities, 183
Clayton, Evelyn B. (Braithwaite, Rachel R., and) : A British Freshwater Nemertine, 237
Clemens, P., and others : Les états de carence en Belgique pendant l'occupation Allemande 1940–1944, *review* by Major J. Marshall, 551
Clews, Dr. C. J. Birkett : Elected to an Imperial Chemical Industries Fellowship at Cambridge, 17
Clibbens, Dr. D. : Symbols Used to Indicate Hydrogen Ion Concentration and Similar Quantities, 176
Clinch, Dr. Phyllis E. M. (McKay, Robert, and) : Frost Injury Simulating Virus Disease Symptoms on Potato Foliage, 449
Cloudsley-Thompson, Capt. J L. . Pigments and Chromatophore Reactions of *Polycelis nigra* and *Planaria lugubris*, 294
  Behaviour of the Common Centipede *Lithobius forficatus*, 537
Clow, Dr. Archibald : Awarded the Blackwell Prize, 45
Clow, Dr. Archibald, and Clow, Mrs. Nan L. · Awarded jointly the senior Hume Brown Prize in Scottish History by the University of Edinburgh, 45
Cocks, H. C (LeBrocq, L. F , and) · Hydrogen Overvoltage as a Factor in the Corrosion of Metallic Couples, 536
Cohen, Dr. John : Measuring the Infant's Mind, *review*, 349
  Origin of Uniformity, *review*, 515
  Interpretation of Fantasy as a Clinical Technique, *review*, 701
Cohn, Edwin J., and Edsall, John T. : Proteins, Amino-Acids and Peptides as Ions and Dipolar Ions, *review* by Dr. Kenneth Bailey, 405
Colhoun, J. (Muskett, A. E., and) : Control of Foot Rot (*Phoma* sp.) of Flax, 538
Collar, A. R. Appointed to the White chair of aeronautical engineering at the University of Bristol, 43
College of Aeronautics : Appointment of the Board of Governors, 200
  Appointment of E. F. Relf as principal, 623
College of Physicians of Philadelphia . Alvarenga Prize for 1945 awarded to Dr. Alexander S. Wiener, 79
Collinge, Dr. Walter E : Duration of Life of Woodlice, 755
Colonial Service : Appointments, 264, 445, 687
Combined Raw Materials Board : Third Annual Report of the, 24
Compton, Dr. Arthur H. . Atomic Energy as a Human Asset, 687
Connely, Willard . Some Comparisons between Universities, 183
Conrad, Victor : Methods in Climatology, *review*, 317
Conway, Prof. E. J., and MacDonnell, Eithne : Carboxylase and Carbonic Acid, 752
Conway, Prof. E. J., and Moore, P. T. : Cation and Anion Permeability Constants for the Muscle Fibre Membrane, 170
  Rate of Entrance of Ammonia into Muscle Fibres in relation to Carbon Dioxide Tension, 270
Conway, Prof. E. J., and others : A Theory of the Formation of Hydrochloric Acid in the Gastric Mucosa, 477
Cook, G. A. : Appointed secretary of the Australian Council for Scientific and Industrial Research, 444
Cook, J. Stewart . Appointed organising secretary of the British Association of Chemists, 362
Coombs, R R A , and Race, Dr. R. R. : Further Observations on the 'Incomplete' or 'Blocking' *Rh* Antibody, 233
Cooper, J. L. B. : Operators in Quantum Theory, 54
Corben, Dr. H. C. : A Classical Theory of Electromagnetism and Gravitation, 388
Corner, George W. : Ourselves Unborn, *review* by Dr. C. H. Waddington 375
Corrêa, Prof. A. A. Mendes : Timor Português, contribuições para o seu estudo antropológico, *review* by Prof. A. R. Radcliffe-Brown, 129
Cott, Dr. Hugh B. : The Edibility of Birds, 736
Cotton, Prof. C. A : Volcanoes as Landscape Forms, *review* by Prof. Arthur Holmes, 156
Cotton Industry Research Association, British · Fellowships, 200, 686
Courant, Prof. R. : Abschnitt uber Geometrische Funktionen, *review* by J. H. Pearce, 67
Coventry Gauge and Tool Co , Ltd , Taylor, Taylor and Hobson, Ltd , and E. R. Watts and Son, Ltd. : To co-operate in the development and distribution of precision engineering and optical equipment, 387
Cowie, A. T., and Folley, Dr. S. J. : Parathyroidectomy and Lactation in the Rat, 719
Cox, Dr. E. G : Appointed to the chair of chemistry in the University of Leeds, 386 ; work of, 386
Cox, Gordon : Awarded a Halford Undergraduate Scholarship by the Veterinary Educational Trust, 473
Cox, L. G. (Randolph, L. F., and) : Germination of Bearded Iris Seeds, 395
Craggs, Dr. J. D., and Meek, Dr. J. M. : Afterglow Effects in High-Pressure Gases, 21
Cramer, Dr. William : *Death* of, 360 ; *obituary* by Dr. R. J. Ludford, 773
Creasey, C. H. (Eve, A. S., and) : Life and Work of John Tyndall, *review* by Lord Rayleigh, 189
Crismer, R., and others : Les états de carence en Belgique pendant l'occupation Allemande 1940–1944, *review* by Major J. Marshall, 551
Croce, Benedetto : Politics and Morals, translated from the Italian by Salvatore J. Castiglione, *review* by Prof. A. D. Ritchie, 281
Croft, D. C : Awarded a Halford Undergraduate Scholarship by the Veterinary Educational Trust, 473
Croll, J. MacA. : Resignation as lecturer in bacteriology in the University of Sheffield, 79
Cross, M H. : Awarded a Boots Undergraduate Scholarship by the Veterinary Educational Trust, 473
Crowther, Dr. E. M. : Agrochemistry in the U.S.S R., 227
  Fertilizers During the War and After, 776
Crowther, J. G. : A United Nations Educational and Cultural Organisation—World Co-operation in Science, 556
Cruickshank, J. C. · Title of reader in bacteriology in the University of London conferred on, 108
Cruickshanks, Dr. G. S. : Retirement as lecturer of fuels at the Royal Technical College, Glasgow, 687
Cumberland, Kenneth B. : Soil Erosion in New Zealand, *review* by G. V. Jacks, 703
Curtis, William : Exhibition at the Curtis Museum, Alton, to commemorate the bicentenary of, 598
Curtis Museum, Alton : Exhibition to commemorate the bicentenary of William Curtis, 598
Cuthbertson, Dr. D. P. : Appointed head of the Rowett Research Institute, 685 ; work of, 685
Czechoslovakian Mathematicians and Physicists, Society of : Conference on the Use of X-Ray Methods in the Metal Industry, 473, 502

DAHLBERG, Prof. Gunnar : Nature, Nurture and Probability, 539
Dale, Sir Henry : A Hitherto Unpublished Letter of Isaac Newton, 193
  Obituary of R. W. F. Harrison and A. G. Hastings White, 228
  The Mission of Science, 677
  Retirement as Fullerian professor of chemistry in the Royal Institution and director of the Davy Faraday Research Laboratory, 714
Dale, I. R. : Appointed senior assistant conservator of forests, Uganda, 264
Dance, A. G. : Microfilm and other Means of Documentary Reproduction, 26
D'Ancona, Prof. Umberto : Sexual Differentiation of the Gonad and the Sexualization of the Germ Cells in Teleosts, 603
Danielli, Dr. J. F. : Reactions at Interfaces and their Significance in Biology, 468
Danielli, Dr. J F., and Catcheside, D. G. : Phosphatase on Chromosomes, 294
Darling, Dr. F. Fraser : A Naturalist of the Highlands, *review*, 219
Darlington, Dr. C. D. : Elected president of the Genetical Society, 202
Darlington, Dr. C. D. (Harland, Dr. S. C., and) . *Obituary* of Prof. N. I. Vavilov, 621
Darmstaedter, Dr. F. : Germany and Europe, *review* by Capt. Maurice Bruce, 551
Das Gupta, N. N. (Ghosh, S. K., and) · Energy Spectrum of Mesotrons at Low Energies, 83
Daudin, Jean . Cosmic Radiation observed at the Col du Lautaret, Hautes-Alpes, 429
Davenport, Prof. Harold : Appointed to the Astor chair of mathematics in the University of London at University College, 443
Davey, Norman : Degree of D Sc. (Eng.) in the University of London conferred on, 533
Davidson, Prof. J. : *Death* of, 290 ; *obituary* by Dr. W. E. Brenchley, 359
Davie, Prof. Thos. B. : The Child's Blood in Health and Disease, *review*, 192
Davies, A. W. : Appointed a research assistant (biochemistry) in the Department of Animal Health at the University College of Wales, Aberystwyth, 331
Davies, C. N. : Early Observation of Antibiotic Action, 666
Davies, Dr. D. V. . Human Embryology, *review*, 315
Davies, Dr. E. B : A Case of Molybdenum Deficiency in New Zealand, 392
Davies, Dr. J. S. H. : Appointed director of research of the British Schering Research Institute, 626
Davies, Dr. W. : Resignation from the temporary assistant lectureship in geology in the University of Sheffield, 473
Deacon, Dr. G. E. R. : Oceanographical Results of the Last Voyage of the U.S. Non-Magnetic *Carnegie*, 341
Decrop, G. (Bailly, J., and) : A propos d'un procédé d'exploration simple de l'état fonctionnel du Foie, 395
De Greve, L. (Van Itterbeek, Prof. A., and) : Resistivity of Thin Metallic Films, 634

Deltombe, J., and others : Les états de carence en Belgique pendant l'occupation Allemande 1940–1944, *review* by Major J. Marshall, 551
DeLury, Dr. J. S. : Presidential Address to Section IV of the Royal Society of Canada, 271
Denne, E. · Pressure Units, 146
Dennis, F. Hamlyn : Electricity—Public or Private Monopoly?, *review* by C. W. Marshall, 585
Denston, T. C. : A Textbook of Pharmacognosy, fourth edition, *review* by Prof. W. O. Howarth, 350
Desch, Dr. C. H. : Microfilm and other Means of Documentary Reproduction, 26
Deutsch, Dr. A., and Ferno, O. : Use of Dibenzylphosphoryl Chloride for Phosphorylations, 604
Dewar, Eric T., and Percival, Dr. E. G. V. : A Polysaccharide from *Gigartina stellata*—the Isolation of Crystalline 2 : 6-Dimethyl-*β*-*d*-Galactopyranose from the Methylated Polysaccharide, 633
Dewar, M. J. S. : Mechanism of the Beckmann Rearrangement, 688
  Mechanism of the Benzidine and related Rearrangements, 784
Diamond, Dr. Louis K. (Blackfan, Dr. Kenneth D., and) : Atlas of the Blood in Children, *review* by Prof. Thos. B. Davie, 192
Dickinson, Dr. Robert E. : The Regions of Germany, *review* by Prof. W. Fitzgerald, 253
Dickinson, Prof. Roscoe G. : *Death* of, 443
Dilthey, Wilhelm—an Introduction (Prof. H. A. Hodges), *review* by Dr. A D. Lindsay, 461
Dimbleby, Squadron-Leader G. W. : Appointed ecologist in the Department of Forestry of the University of Oxford, 293
Dingle, Prof. H. : Science and Religion, 232
  Cosmic Rays and Kinematical Relativity, 389
  Physics and Astrophysics at the Imperial College, 562
  Kinematical Relativity, 748
Dirac, Prof. P. A. M. : Quantum Electrodynamics, 704
Divry, A., and others : Les états de carence en Belgique pendant l'occupation Allemande 1940–1944, *review* by Major J. Marshall, 551
Dixey, Dr. F. : Nigeria, its Geology and Mineral Resources, 362
Dixon, Dr. Malcolm (Caputto, Ranwel, and) : Crystallization and Identity of the Triose and Triosephosphate Dehydrogenases of Muscle, 630
Dobell, Dr. Clifford : *Obituary* of Prof. F. Vejdovský, 530
Dobzhansky, Th. : Awarded the Daniel Giraud Elliot Medal for 1941 of the United States National Academy of Sciences, 575
Dodd, B. E., and others : Enhancement of the Action of Immune Hæm-Agglutinins by Human Serum, 663
Dolejšek, Prof V. : *Obituary* by Dr. G. Druce, 75
Dollard, John (Miller, Neal E , and) : Social Learning and Imitation, *review* by Dr. John Cohen, 515
Donald, Dr. H. P. : Pig Production, 454
Donaldson, Frances · Four Years Harvest, *review* by Sir John Russell, 280
Doren, A. V., and others : Use of Carbon Dioxide in Fruit Storage and Transport, 178
Doren, A. V., and Hoffman, M. B. : Biennial Bearing of Apple Trees, 304
Double, E. W. W. : Tensile Load on Steel-Cored Aluminium Conductors, 305
Douglas, Dr. C. G. . Awarded the Osler Medal for 1945, 17
Dowsen, E. Yale : Annotated List of the Marine Algæ and Marine Grasses of San Diego, California, 533
Drew, Dr. Kathleen M. : Use of Hydrochloric Acid for Softening Algal Tissues for Microtome Sections, 479
Druce, Dr. G. : *Obituary* of Prof E. Rádl, 14
  Obituaries of Some Czechoslovak Men of Science, 75
Drury, Dr. A. N. : Appointed a member of the Industrial Health Research Board of the Medical Research Council, 566
Dublin Institute for Advanced Studies · Summer School of the, 704
Dubois, L., and others : Les états de carence en Belgique pendant l'occupation Allemande 1940–1944, *review* by Major J. Marshall, 551
Duckham, A N. : Appointed British Agricultural Attaché at Washington and Agricultural Adviser at Ottawa, 138
Duckworth, Capt. Arthur Dyce : Appointed secretary of the Institution of Naval Architects, 502
Dufay-Chromex, Ltd. . A New Film-Strip Projector, 264
Duff, C. E. . Appointed senior assistant conservator of forests, Northern Rhodesia, 445
Dumont, L , Dumont-Ruyters, L., and others · Les états de carence en Belgique pendant l'occupation Allemande 1940–1944, *review* by Major J. Marshall, 551
Duncan, D. G., and Zwarenstein, Dr. H. : Congo Red Fibrin Powder for Experiments on Proteolytic Enzymes, 112
Duncan, F. Martin : The Molluscan Family Planorbidæ (Frank Collins Baker), *review*, 765
Dunn, B · A Photographic Method of Deriving Isoclinics in Photo-elastic Methods, 480
Dunsheath, Dr. P. : British Electrical Engineers and the War, 482
Dunstan, Sonia, and others : Application of New Methods of End-Group Determination to Structural Problems in the Polysaccharides, 785
Dupouy, Prof : Cosmic Rays, 544
Durán, Dr. Hernán, and others : Fluorescence Microscopy of Tubercle Bacilli, 16
Duran-Jorda, Dr. F. : Cell Contents of Pus, 110
Durand, William Frederick : Awarded the fifth John J. Carty Medal and Award of the United States National Academy of Sciences, 575
Durban Museum and Art Gallery : Annual Report for 1943–44, 331
Durham, Dr. H. E . *Death* of, 657 ; *obituary* by Dr. G. Lapage, 742
Durham Colleges : Appointment of Dr. David H. Valentine to the readership in botany in the, 140
Duthie, Ruth (Blaschko, Dr. H., and) : Action of Mepacrine on Diamine Oxidase, 113
Dutta, Ajit Kumar : Effect of Temperature on Magnetic Susceptibility of Molybdenite Crystals, 240
Dyer, Dr. Helen H. : Mammary Tumours in Mice, 787

ECCLES, Prof. J. C. · An Electrical Hypothesis of Synaptic and Neuromuscular Transmission, 680
Eccles, Dr. W. H : Tribute to the Influence of the Imperial College of Science and Technology, 520
Ecological Society, British : Memorandum on the Establishment of an Aerial Unit for Scientific Work, 2
Economics, Engineers' Study Group on : Annual General Meeting, 686
Edgecombe, Prof. A. E. : *Death* of, 415
Edlén, Prof. Bengt : The Spectral Structure of the Inert Gases, 445
Edmondson, Charles Howard : Callianassidæ of the Central Pacific, 395
Edsall, John T. (Cohn, Edwin J., and) : Proteins, Amino-Acids and Peptides as Ions and Dipolar Ions, *review* by Dr. Kenneth Bailey, 405
Education, Ministry of : Report on Higher Technological Education, 699
  (Iron and Steel Institute, the Institution of Mining and Metallurgy, and the Institute of Metals, in co-operation with the) . To establish a scheme for National Certificates in Metallurgy, 138
Education in H M. Forces, Central Advisory Council for : Report for 1944–1945, 107
Edward's (King) Hospital Fund for London : Second Memorandum on Hospital Diet, 725
Edwards, G. R. : Microfilm and other Means of Documentary Reproduction, 25
Edwards, W. N. : Geology and Palæobotany in the U S.S.R., 282
Eeckhout, Dr. J. : Spectral Analysis of Solid Substances, 175
Egerton, Sir Alfred : Visit to Prague to convey the greetings of the Royal Society to men of science in Czechoslovakia, 416
Egerton, Sir Alfred (Callendar, G. S., and) : The 1939 Callendar Steam Tables, second edition, *review* by Dr. H. Heywood, 462
Eggeling, W. J. . Appointed conservator of forests, Uganda, 687
Eklund, Sigvard : An Attempt to obtain Nuclear Excitation by means of X-Rays, 690
Ekstrand, Torsten, and Sjögren, Bertil : Production of *p*-Aminobenzoic Acid by the Tubercle Bacillus, 476
Electrical Association for Women : Exhibition to mark its twenty-first anniversary, 387
Elles, Miss G. L., and Shakespear, Dame Ethel : *Obituary* of Miss E. R. Saunders, 198
Ellinger, Dr. P. : Biochemical Aspects of Mental Disorder, 103
Elliot, G. Fielding : Science and Foreign Policy, 63
Elliott, Dr. A. · Resignation as lecturer in physics in the University of Sheffield, 745
Ellis, Sir William H : *Death* of, 42 ; *obituary* by J. F. Bridge, 290
Ellis, William J. : Cultures of *Bacterium brunneum*, 365
Ellis, W. J., and others : Fundamental Investigations on the Fellmongering Process, 483
Elmer, A. D. E. : *Death* of, 199
Elsdon-Dew, Major R. : Amœbiasis in Durban, 118
Emmet, Dorothy M. : The Nature of Metaphysical Thinking, *review* by Prof. L. J. Russell, 217
Enfield, R. R : Appointed chief economic adviser to the Ministry of Agriculture and Fisheries, 687
Engineering (Agricultural), National Institute of : Publication of No. 1 of the *Agricultural Engineering Record*, 232, 500
Engineers' Study Group on Economics : Annual General Meeting, 686
Engineers (Chemical), Institution of, the Institute of Physics and the Chemical Engineering Group of the Society of Chemical Industry : Joint conference on Instruments for the Automatic Controlling and Recording of Chemical and other Processes, 45, 723
Engineers (Civil), Institution of : Field-Marshal the Hon. Sir Harold Alexander and Sir Edward Appleton elected honorary members, 598
Engineers (Electrical), Institution of . Award of Premiums, 17
  Election of officers, 108
  Annual Report for the Year 1944–45, 139
English, H., and others : Use of Carbon Dioxide in Fruit Storage and Transport, 178
Ennis, C. C., and others : Observations and Results in Physical Oceanography, 341
Epstein, Dr. M (edited by) : The Annual Register for the Year 1944, *review*, 489
  The Statesman's Year Book for 1945, *review*, 614
Esben-Petersen, Peter : *Death* of, 415
Esdaile, Dr. Arundell · Microfilm and other Means of Documentary Reproduction, 26
'Espinasse, Paul G. : Appointed lecturer and head of the Department of Zoology in the University College of Hull, 777
Euler, Prof. U. S. v. : A Sympathomometic Pressor Substance in Animal Organ Extracts, 18
Euler, Prof. U. S. v., and Östlund, E. : An Undialysable Pressor Principle in Organ Extracts, 49
Evans, Dr. A. G. : Friedel-Crafts Catalysts and Polymerization, 638
Evans, Dr. A. G., and Polanyi, Prof. M. : Low Temperature Polymerization, 638
Evans, Prof. C. Lovatt : A Great Physiologist, *review*, 764
Evans, Sir Geoffrey . *Obituary* of Prebendary Lonsdale Ragg, 289
Evans, Prof M. G · Appointed to the chair of chemistry in the University of Leeds, 386
  Energy Transfer in Chemical Reactions, 639
Evans, R. A. : Appointed a research assistant (biochemistry) in the Department of Animal Health at the University College of Wales, Aberystwyth, 331
Evans, Dr. U R. (Rideal, Prof E. K., and) : *Obituary* of Prof. Leif Tronstad, 74
Evans, Dr. W. C. : Appointed special lecturer in biochemistry in the Department of Animal Health at the University College of Wales, Aberystwyth, 331
Eve, A. S., and Creasey, C. H. : Life and Work of John Tyndall, *review* by Lord Rayleigh, 189
Ewer, Dr. D. W. : Acoustic Control in the Flight of Bats, 692
Exploration of the Sea, International Council for the : Reconstitution of the, 597

FAHRENHORST, Eberhard (Bulian, Walter, and) · Metallography of Magnesium and its Alloys, translated by the Technical Staffs of F. A. Hughes and Co , Ltd., and Magnesium Elektron, Ltd., *review*, 614
Fairbrother, Dr. F. : The Catalytic Halides, 638
Fairburn, C. E. : *Death* of, 596
Fairburn, W. A. : Appointed conservator of forests, Nigeria, 687
Fairweather, Dr. Alan : Closure and Partial Separation of a Metallic Contact, 545

Faraday, Dr. Joseph E. : Encyclopedia of Hydrocarbon Compounds, Replacement-addition issue of C_1 to C_8, 744
Farber, Prof. Marvin : The Foundation of Phenomenology—Edmund Husserl and the Quest for a Rigorous Science of Philosophy, *review* by F. Ian G. Rawlins, 516
Farmer, Dr. E H. . Oxidative Breakdown of Rubber, 10
Farrington, A : Lowering of Sea-Level in Glacial Times, 396
Fawcett, G. S : *Death* of, 596
Fazal-Uddin (Madhok, Dr. M R., and) : Losses of Nitrous Nitrogen from Soils on Desiccation, 49
Feather, Prof. Norman . Appointed professor of natural philosophy in the University of Edinburgh, 415 ; work of, 415
  American Work on the Atomic Bomb Project, 768
Federation of British Industries : Appointment of B. J. A Bard as head of the F.B.I Research Secretariat and secretary of the F.B.I. Industrial Research Committee, 77
Federov, V K. Research on Conditioned Reflexes, 455
Feinberg, Dr. R : Units for Degree of Vacuum, 85
Ferguson, Prof. T. : Appointed a member of the Industrial Health Research Board of the Medical Research Council, 566
Fermor, Sir Lewis : *Obituary* of C. S. Middlemiss, 594
  Organisation of Scientific Research in the British Commonwealth, 758
Ferno, O (Deutsch, Dr A., and) : Use of Dibenzylphosphoryl Chloride for Phosphorylations, 604
Fersman, Prof. Alexander . *Obituary* by Prof. C E. Tilley, 12
  The Periodic Law and its Significance for Natural Science (*VOKS Bulletin* No. 6), 331
Fidler, D. N. : Appointed research assistant (animal husbandry) in the Department of Animal Health at the University College of Wales, Aberystwyth, 331
Field Studies Council, West of Scotland : Inauguration of the, 331
Fiennes, R. N. T.-W- . A Sexual Reproduction Cycle of *Trypanosoma congolense* Broden, 390
Fieser, Louis F., and Fieser, Mary : Organic Chemistry, *review* by Prof. John Read, 96
Finch, Prof G. I. : Some Comparisons between Universities, 184
  Visit to Belgium and Holland to convey the greetings of the Royal Society, 472
Fisher, Prof. R. A. : A New Test for 2 × 2 Tables, 388
Fishlock, C. W. L. : Appointed senior agricultural officer, Uganda, 445
Fishwick, V C. : Pigs, revised edition, *review* by Dr. John Hammond, 434
FitzGerald, O., and others : A Theory of the Formation of Hydrochloric Acid in the Gastric Mucosa, 477
Fitzgerald, Prof W. : A Plan for Decentralizing Administration in Germany, *review*, 253
  The Geographer as Humanist, 355
Fleming, Sir Alexander : Appointed a member of the Medical Research Council, 362
  Awarded the Moxon Medal of the Royal College of Physicians, 531
  Nobel Prize for Medicine for 1945 awarded jointly to Sir Howard Florey, Dr E. B. Chain and, 533, 564
Fleming, Dr. John A. : Awarded the third Charles Chree Medal and Prize of the Physical Society, 658 ; work of, 658
Fleming, Dr J. A , and others : Observations and Results in Physical Oceanography, 341
Flemmich, C. O , and others : Need for Development of Tropical Ecological Studies, 627
Florey, Sir Howard : Nobel Prize for Medicine for 1945 awarded jointly to Sir Alexander Fleming, Dr. E. B. Chain and, 533, 564
Florkin, Prof. Marcel : Léon Fredericq et les débuts de la physiologie en Belgique, *review* by Prof. C. Lovatt Evans, 764
Flower, Newman : Through my Garden Gate, *review*, 614
Flugel, Dr. J. C. : The Scapegoat in Modern Europe, 380
Foggie, A. : Appointed senior assistant conservator of forests, Nigeria, 264
Foister, Dr. C. F , and others : Control of Dry Rot of Seed Potatoes by Dusting, 394
Foley, E J , and others : 'Fissibactericidal' Nature of Penicillin Action, 49
Folley, Dr. S. J. (Cowie, A T., and) : Parathyroidectomy and Lactation in the Rat, 719
Forde, Prof. C Daryll : Appointed to the University of London chair of anthropology at University College, 76
Forrest, J. S : The Corrosion of Metals, 438
Forrester, Lord : Appointed a member of the Industrial Health Research Board of the Medical Research Council, 566
Forrester, W F., and Hinde, R. M. : Crystal Structure of Barium Titanate, 177
Forster, Sir Martin : *Obituary* by Prof. J. L. Simonsen, 13
Forsyth, G. H. . Appointed to the chair of mechanical and marine engineering at King's College, Newcastle-upon-Tyne, 140
Forsyth, Dr. J. S Appointed Brotherton lecturer in chemical engineering at the University of Leeds, 659
Foster, Dr. Maunder . Strength of Materials, 307
Fowler, Henry B Description of a New Genus and Species of Apogonid Fish from New Jersey, 395
Fox, Sir Cyril : A Find of the Early Iron Age from Llyn Cerrig Bach, Anglesey, 309
Fox, Prof. H Munro . Individual Hæmoglobins, 18
  Appointed a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research, 473
  Hæmoglobin in Blood-sucking Parasites, 475
Fraenkel, Prof. W. H. *Obituary* by E Scheuer, 773
Franklin Institute : Reports of the Biochemical Research Foundation, 331
Fredericq (Léon) et les débuts de la physiologie en Belgique (Prof. Marcel Florkin), *review* by Prof. C Lovatt Evans, 764
Freedom in Science, Society for . Occasional Pamphlet No. 1, Is the Progress of Science Controlled by the Material Wants of Man? (Dr. F. Sherwood Taylor), 166
French Association for the Advancement of Science : Congrès de la Victoire, 532
Fréon, A. : Cosmic Rays, 543
Freudenthal, Dr. Walter . Appointed to the University of London readership in dermatological histology at University College Hospital Medical School, 714
Friedenwald, Prof. Harry : The Jews and Medicine, *review* by Dr. Walter Pagel, 31
Friedmann, Dr. E. (Laser, Dr H., and) . Crystalline Hæmolytic Substance from Normal Blood, 507
Frilley, M Cosmic Rays, 544
Fritsch, Prof. F E. : Ceratium and Marine Hydrography, 181
Fuel, Institute of : Elections, 45
  Appointment of R. W. Reynolds-Davies as deputy secretary, 329
Fulton, J D : Penicillin in Leishmania Infections, 203
Furth, Dr. R., and others : A Photo-Electric Fourier Transformer, 756

GADDUM, Prof. J. H. : Lognormal Distributions, 463, 747
  Obituary of Prof. Velyien Henderson, 683
Gage, Prof George R. : *Death* of, 471
Gagnon, Dr Paul : Appointed a member of the National Research Council of Canada, 416
Gale, Miss M R. : Some Comparisons between Universities, 184
Galotchkina, L. P. (Kravkov, Prof. S V , and) Electrotonus in Colour Vision, *erratum*, 626
Gardiner, Prof. J Stanley : *Obituary* of Dr. L. A Borradaile, 622
Gardner, R (Bryant, L R , and) . Phosphorus Deficiency of Fruit Trees, 178
Garnier, Dr Georges : Cervico-Facial Pigmentation (Melanosis of Riehl-Poikiloderma), translated by Major James Marshall, 163
  Relation of the Gonadal Hormones to certain Dermatoses, translated by Major James Marshall, 163
Garrick, F. J. . Time, Number and the Atom (R. Fortescue Pickard), *review*, 489
Garrod, Prof. L. P : Visit to Belgium to lecture on Penicillin, 533
Gas Light and Coke Company : To broaden its research programme, 202
Gas Research Board : Fifth Annual Report, 370 ; *erratum*, 387
Gause, Prof G. F : Properties of Optically Isomeric Mepacrines, 784
Gauzit, J , and others Infra-Red Spectrum of the Night Sky, 114
Gaviola, Enrique : What are Comets?, 79
Gayler, Dr. M L. V. . Striated Structure of Age-hardened Alloys, 333
Geddes, Patrick (Philip Boardman), *review* by R. Brightman, 612 ; *erratum*, 687
Genetical Society : Election of officers, 202
  Special meetings, 473
Geographical Society, Royal : Exhibition of German Military Maps, 445
  Appointment of Lieut -Colonel L. P. Kirwan as secretary, 445
  Christmas Lectures, 714
Geological Society of London : Fund to defray the costs of an instructional tour for students, 533
Geological Survey of Great Britain : Appointment of Dr. W. F. P. McLintock as director, 168, 329
Geological Survey (Scottish Office) : Retirement of Dr. Murray Macgregor, 743
  Appointment of T. H Whitehead as director, 743
Gerhardt, F , and others : Use of Carbon Dioxide in Fruit Storage and Transport, 178
Ghosh, Sir J. C , and Sastry, S. L. : Chromium Oxide as a Promoter in Catalysts for the Fischer-Tropsch Synthesis, 506
Ghosh, S K , and Das Gupta, N. N : Energy Spectrum of Mesotrons at Low Energies, 83
Giffen, Dr. Edmund . Appointed to the chair of civil and mechanical engineering at Queen Mary College, London, 137 ; work of, 137
Gilbert, P T. : The Corrosion of Metals, 437
Gilbert, jr., Wm H. : Peoples of India, 292
Gillespie, Dr R. D. : *Death* of, 596
Gillman, Dr. J., and others : Porphyrin Fluorescence in the Livers of Pellagrins in relation to Ultra-Violet Light, 689
Glaxo Laboratories, Ltd. : Demonstration of the preparation of Penicillin, 386
Gleissberg, Dr. W. : A Forecast of Solar Activity, 539
Glock, Dr. Gertrude E. : Thiourea and the Suprarenal Cortex, 508
Gluckauf, Dr. E. . Chromatography of Two Solutes, 205, 571
  Adsorption Isotherms from Chromatographic Measurements, 748
Godsil, H C., and Byers, Robert D. : A Systematic Study of the Pacific Tunas, 184
Godwin, Dr. H : Hay-fever Plants, *review*, 317
  Archives of the Lakes, 383
Golberg, Dr Leon, and others : B Vitamins in African Fermented Foods, 364
González, Dr. Gastón, and others . Fluorescence Microscopy of Tubercle Bacilli, 16
Goodeve, Dr. C. F. : Appointed director of the British Iron and Steel Research Association, 138, 472
  Retirement from the post of deputy controller for research and development in the Admiralty, 472
Goodey, Dr. T. : Calomel and Onion Eelworm, 393
Goodlet, Commander B. L. : Elected a fellow of the Royal Society of South Africa, 687
Goodliffe, Frank : The Film in Science, 426
Goodwin, Dr. E. T. . Resignation from the lectureship in mathematics in the University of Sheffield, 473
Goodwin, L G. : Oedema in Hamsters Inected with *Leishmania*, 476
Gordon, Dr. C. : Organisation of Scientific Research in the British Commonwealth, 758
Gordon, Seton : A Highland Year, *review* by Dr. F. Fraser Darling, 219
Gore, Robert C., and others . Infra-red Spectroscopy, *review* by Dr. H. W. Thompson, 65
Gottschalk, Dr A. . Yeast Hexokinase and its Substrates *d*-Fructofuranose and *d*-Glucose, 540
Gough, Dr. H. J. . Released by the Ministry of Supply, 168
  Appointed engineer-in-chief of Lever and Unilever, Ltd., 202, 290 ; work of, 290
Gough, V. E. (Powell, E. F., and) : The Mechanism of Rubber Cracking, 11
Graham, Edward H. : Natural Principles of Land Use, *review* by Sir John Russell, 675
Graham, H. W., and Bronikovsky, N The Genus *Ceratium* in the Pacific and North Atlantic Oceans, 181
Graham, H. W., and Moberg, Erik G. : Chemical Results of the last Cruise of the *Carnegie*, 341
Grape, Dr. Anders . A Recently Discovered Manuscript by Linnæus, 351

Grassland Improvement Station : Sir George Stapledon to retire from the directorship, 598
Grassland Society, British First meeting of the, 78
Gray, Elizabeth G., and others : Blind Seed Disease of Rye-Grass, 178
Gray, Prof J. A. : Reappointed a member of the National Research Council of Canada, 416
Gray (Thomas) Memorial Trust : Prize and Award under the, 17
Grayson, Miss Dorothy : The Science Film in Education, 426
Greaves, E. G. N. Appointed deputy Government chemist, Trinidad, 687
Green, A. A. (Parkin, E. A, and) : Toxicity of D D T. to the Housefly, 745
Green, Dr. H. L. H. H : *Obituary* of Prof. J. T. Wilson, 772
Green, Prof H. N. (Bielschowsky, F., and) : An Induced Carcinoma in the Fowl, 780
Green, Prof. H. N. (Bielschowsky, Márian, and) : Synthesis of Adenosine Triphosphate by an Enzyme System of Ischæmic Muscle, 117
Greenstein, Dr. J. P. : Mammary Tumours in Mice, 787
Greenwood, Prof. Major : Retirement from the University of London chair of epidemiology and vital statistics at the London School of Hygiene and Tropical Medicine, 43
Gregory, J N, and others : Lubrication of Metal Surfaces by Fatty Acids, 97
Gregory, Sir Richard : Tribute to the influence of the Imperial College of Science and Technology, 519
Greig, Dr James : Appointed to the University of London chair of electrical engineering at King's College, 660
Gresford, Guy B . The Scientist and the Economic and Social Council, 625
Greville, Dr G D : Biochemical Aspects of Mental Disorder, 101
Grew, K. E. : Effect of Pressure on Thermal Diffusion in Gases, 267
Griffith, A L., and others : Need for Development of Tropical Ecological Studies, 627
Grimes, W. F. : Appointed keeper and secretary of the London Museum, 660
Grinnell, Joseph, and Miller, Alden H. . The Distribution of the Birds of California, *review*, 34
Grunberg, L., and Nissan, Dr A. H. . Viscosity of Ordinary Liquids at High Rates of Shear, 241
  Degree of Association of Water from the Energy of Viscosity and the Work of Cohesion, 335
Grzybowski, S . Some Comparisons between Universities, 183
Gudger, Dr E W : Completion of the Bashford Dean Memorial Volume on Archaic Fishes, 533
Guha, B S., and others (edited by) : Essays in Anthropology Presented to Rai Bahadur Sarat Chandra Roy, *review* by Prof. J. H Hutton, 66
Gunn, Dr D. L, and others . Mass Departure of Locust Swarms in relation to Temperature, 628
Gurney, C. : Strength of Materials, 306
Gurney, Dr. O. R. . Appointed Shillito reader in assyriology in the University of Oxford, 140
Gutenberg, B., and Richter, C. F. : Frequency of Earthquakes in California, 371

HACKETT, Wing-Comdr C J. : Appointed director of the Wellcome Museum of Medical Science, 416
Hadingham, Squadron-Leader Ronald : Astronomical Air Navigation, second edition, *review*, 489
Hafez, Dr. M. : Bionomics of *Hylemyia cinerella* Fallen, 48
Hahn, Prof. Otto : Awarded the Nobel Prize for 1944 for Chemistry, 657 ; work of, 657
Hainsworth, C. H. . Retirement as lecturer in electrical engineering in the University of Sheffield, 79
Haïssinsky, M. : Anodic Deposit of Protactinium, 423
Halberstadt, E. S., and others : Univalent Electron Transfers in Aromatic Nitration?, 688
Haldane, Prof. J. B S : Cosmic Rays and Kinematical Relativity, 266
  Obituary of Miss E. R. Saunders, 385
Halnan, E. T. (Marshall, Dr. F. H. A, and) : Physiology of Farm Animals, third edition, *review* by Dr. John Hammond, 377
Halsall, T G : Awarded a Shirley Fellowship by the British Cotton Industry Research Association, 686
Halsall, T. G, and others : Application of New Methods of End-Group Determination to Structural Problems in the Polysaccharides, 785
Hamilton, S. B : Re-elected president of the Newcomen Society, 758
Hamilton, Prof. W J, and others : Human Embryology, *review* by Dr. D V. Davies, 315
Hammick, D. Ll., and Mason, S F. : Primary Degradation Products of Mepacrine in Human Urine, 718
Hammond, Dr. John : The Animal in Health, *review*, 377
  Science and Pig-keeping, *review*, 434
  Pig Production, 454
Handley, Dr W. R. : Appointed microbiologist in the Department of Forestry of the University of Oxford, 293
Hankey, Lord : Government Control in War, 457
Hannell, F. G Resignation as lecturer in geography in the University of Sheffield, 745
Hanson, Dr. Frank Blair : *Death* of, 199
Harding, D. W. : Appointed to the University of London chair of psychology at Bedford College, 108
Hardy, Prof. A. C. : Appointed Linacre professor of zoology and comparative anatomy in the University of Oxford, 108, 200 , work of, 200
Hardy, Prof. G H. : Work of, 76
Harkness, D. A E. : Appointed principal assistant secretary in charge of the Economics and Statistics Division of the Ministry of Agriculture and Fisheries, 687
Harland, Dr S. C., and Darlington, Dr. C D. *Obituary* of Prof. N I. Vavilov, 621
Harley, J L., and others : Need for Development of Tropical Ecological Studies, 627
Harris, Prof. John E. : Anomalous Inactivation of Heavy Metal Antifouling Paints, 206
Harris, J. R., and Hickey, Dr. M. D. : Occurrence of the Diphyllobothriidæ in Ireland, 447
Harris, Dr L. J., and Kodicek, Dr. E : The Vitamin B_2 Complex, 86
Harris, R. V. Degree of D.Sc. of the University of London conferred on, 108
Harrison, H C. : Weathering of GR-S, 10
Harrison, Dr. J V. . *Obituary* of Brigadier-General Sir Percy Sykes, 104
Harrison, R. W. F. : *Death* of, 106 ; *obituary* by Sir Henry Dale, 228
Hartridge, Prof H : Avoidance of Obstacles by Bats, 55
  An Illusion of Size, 118, 636
  Acoustic Control in the Flight of Bats, 490, 687, 692
  The Anti-Chromatic Reflex, 666
Hartshorn, Dr. L., and Wilson, W. : An Electrical Moisture Meter, 16
Hartwell, Dr. Gladys A. : Title of University of London reader in nutritional science conferred on, 566
Haslam, J. (Clark, L. M., and) : Occurrence of Boron Phosphate in Fireside Deposit from an Economizer, 302
Haurwitz, Prof. Bernhard, and Austin, Prof. James M. : Climatology, *review* by Prof. D Brunt, 157
Hawkins, Major T. H. : The Army School of Education, Eltham Palace, 527
  Timber Resources of Britain, *review*, 613
Hawksley, P. G. W. (Brown, R L, and) : Packing of Regular (Spherical) and Irregular Particles, 421
Hawley, W. G. . Surge Characteristics of the Three-Phase Transmission Line with Earth Wire, 305
Hayes, Prof. K A : Automatic Control and Recording in Chemical and other Processes, 724
Hayes, R. C. : Earthquakes in New Zealand during 1942 and 1943, 396
Hearne, George W., and others . Halogenation in the Allyl Position, 53
Heath, L. (Yarnold, Dr. G. D, and) : Lantern Slides of Line Drawings, 574
Heatley, N. G. (Kent, J., and) : Antibiotics from Moulds, 295
Heaviside's Operational Calculus Made Easy (Dr. T. H Turney), *review* by Dr. L. E. C Hughes, 6
Heilbron, Prof. I. M. : Appointed a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research, 473
  Visit to Paris to re-establish contact with French men of science, 473
Heitler, Prof W. . Cosmic Rays, 543
Henderson, Dr. James . Appointed academic registrar of the University of London, 533
Henderson, J. L. : Some Comparisons between Universities, 184
Henderson, Prof V. E. *Death* of, 596 ; *obituary* by Prof. J. H. Gaddum, 683
Henry, Dr. M, and others : Nature of the Gram-positive Complex in Micro-organisms, 720
Herington, E. F G. (Campbell, H., and) : Interaction of Aluminium Halides with the Xylenes, 389
Herman, R, and others : Infra-Red Spectrum of the Night Sky, 114
Hertfordshire Institute of Agriculture : Copies of *Nature* for disposal, 362
Heston, Dr W. E. : Mammary Tumours in Mice, 787
Hevesy, Prof. G. : Sixtieth Birthday Celebrations, 106
Hevesy, Prof. G, and Ottesen, J. . Life-Cycle of the Red Corpuscles of the Hen, 534
Hewitt, E. J, and others : Determination of Factors Injurious to Plants in Acid Soils, 778
Hey, Dr. D. H. : The New Organic Chemistry, 36
  Appointed to the University of London chair of chemistry at King's College, 108, 140
Heymann, Dr. E., and Bloom, H. : Activation Energy of Ionic Migration in Molten Salts, 479
Heymans, Prof. C. : Influence of Blood Pressure and Blood Flow on the Activity of the Respiratory, Vasomotor and Cardio-Regulatory Centres, 750
Heywood, Dr. H : Steam Tables and Steam Power, *review*, 462
Hickey, Dr. M D (Harris, J. R., and) : Occurrence of the Diphyllobothriidæ in Ireland, 447
Hickin, Dr N. E. Mode of Entry of Contact Insecticides, 753
Hickman, Dr. K. C D : Performance of Diffusion Pumps, 635
Highfield, J. S. : *Death* of, 290
Higman, Flight-Lieut. Bryan : Mechanism of the Beckmann Rearrangement, 242
Hilger, Ltd., Adam : Appointment of Group-Captain A. C. Menzies as controller of research and development, 624
Hill, Prof. A Bradford . Appointed a member of the Industrial Health Research Board of the Medical Research Council, 566
Hill, Prof. A. V. : Retirement from the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research, 473
Hill, Major K. R., and Robinson, G. : A Fatal Case of D.D.T. Poisoning in a Child, 780
Hill, R. A. : Automatic Control and Recording in Chemical and other Processes, 724
Hillstead, A F. C. : The Blackbird, *review* by Sir D'Arcy Thompson, 318
Hinde, R M. (Forrester, W. F, and) Crystal Structure of Barium Titanate, 177
Hindle, Dr E. . *Obituary* of Prof. Eugène-Louis Bouvier, 42
  Obituary of Dr. G. C. Robson, 75
  Obituary of Sir Peter Chalmers Mitchell, 103
  Elected president of the Institute for the Study of Animal Behaviour, 566
Hinshelwood, Prof. C. N. : Physical Chemistry in the U S S.R., 283
Hinton, M. A. C. : Retirement as keeper of the Department of Zoology, British Museum (Natural History), 43
Hiroa, Te Rangi (Peter H. Buck) : Arts and Crafts of the Cook Islands, 61
Hirst, Prof. E. L., and others . Application of New Methods of End-Group Determination to Structural Problems in the Polysaccharides, 785
Hirst, T . Appointed deputy director of the Geological Survey, Gold Coast, 687
Ho, Dr. : Cosmic Rays, 543
Hobbins, R, and others : Need for Development of Tropical Ecological Studies, 627
Hobbs, R. E. T. . Appointed senior agricultural officer, Kenya, 264
Hobhouse, Sir Arthur : Appointed chairman of the National Parks Committee, 108
Hoch, H., and Morris, C. J. O. R. : Heterogeneity of Human Serum Albumin, 234
Hocking, William Ernest : Science and the Idea of God, *review*, 281
Hodges, Prof. H. A. : Wilhelm Dilthey—an Introduction, *review* by Dr. A. D. Lindsay, 461
Hoffman, M. B., and Van Geluwe, J. D. : Biennial Bearing of Apple Trees, 304
Hoffman, M. B, and others : Use of Carbon Dioxide in Fruit Storage and Transport, 178
Hoffman, M. B. (Doren, A. V, and) : Biennial Bearing of Apple Trees, 304

Hogg, A. H. A. : Elected to an Imperial Chemical Industries Fellowship at Cambridge, 17
Holbourn, Dr. A. H. S. : Awarded the first Charles Vernon Boys Prize of the Physical Society, 685
Hole, Christina : Witchcraft in England, *review*, 765
Hollings, Dr. H. : Appointed controller of research to the Gas Light and Coke Company, 202
Holmes, Prof. Arthur : Genetic Types of Manganese Deposits, 87
  Volcanic Forms and Structures, *review*, 156
  The Giant's Causeway, 425
Holmes, C. H., and others : Need for Development of Tropical Ecological Studies, 627
Holmes, Dr. Gordon : The Organisation of the Visual Cortex in Man, 201
Hopwood, Dr. A. T. · *Obituary* of L. E. Adams, 470
Hora, Dr. Sunder Lal : Indian Fishes and Fisheries, 511
Horgan, Dr. E. S , and Satti, Mohamed Hamed : Penicillin in Kala Azar, 297
Hornblower, A. B : Retirement as honorary general secretary of the London Natural History Society, 108
Horticultural Society, Royal : Offer of the Jones-Bateman Cup for original research in fruit culture, 17
Horton, Dr. Robert E. : *Death* of, 42
Howard, Sir Herbert : A Note on 'Post-War Forest Policy in India', 286
Howarth, Prof. W O. : Teaching of Pharmacognosy, *review*, 96
  Pharmacognosy, *review*, 350
Howlett, F. S. : Biennial Bearing of Apple Trees, 304
Hubbard, C. E. : Taxonomy of *Imperata cylindrica* (L.) Beauv., 342
Hudson, Dr J. C. : The Corrosion of Metals, 436
Huggins, H. D. : Appointed agricultural economist, Jamaica, 445
Hughes, Prof E. D. : To deliver the Tilden Lecture of the Chemical Society, 777
Hughes, Prof. E. D., and others : Univalent Electron Transfers in Aromatic Nitration?, 688
Hughes, Dr. L. E. C. : Operational Calculus, *review*, 6
  Waveform Analysis (R G. Manley), *review*, 765
Hulme, Dr. H. R. · Appointed scientific adviser to the Air Ministry, 745
Humason, M L. : Supernova in Canes, 777
Hunter, Dr A. : A New Cosmogony of the Solar System, 378
  A Physical Theory of the Solar Corona, 649
Hunter, Dr. D. : Appointed a member of the Industrial Health Research Board of the Medical Research Council, 566
Hunter-Smith, J. D : Appointed agricultural officer, Tanganyika, 687
Hurst, Dr. H : Enzyme Activity as a Factor in Insect Physiology and Toxicology, 194
Hurst, Dr J. E. : To be Sheriff of the City and County of Lichfield, 417
Hurwitz, Prof. Adolf : Vorlesungen uber allgemeine Funktionentheorie und elliptische Funktionen, dritte auflage, *review* by J. H. Pearce, 67
Husserl (Edmund) and the Quest for a Rigorous Science of Philosophy : The Foundation of Phenomenology—(Prof. Marvin Farber), *review* by F. Ian G. Rawlins, 516
Hutchinson, John · Common Wild Flowers, *review* by Prof. F. J. Lewis, 461
Hutton, Prof. J. H. : Symposium on India, *review*, 66
Hutton, Dr. R. S : Microfilm and other Means of Documentary Reproduction, 26
Huxley, Dr. Julian S. : Genetics and Major Evolutionary Change, *review*, 3
  Receipt of a letter from Prof. C. J. Van der Klaauw, 166
  Evolutionary Biology and related Subjects in the U.S.S.R., 254 ; *errata*, 293
  A United Nations Educational and Cultural Organisation—Science and the United Nations, 553
  Late Flowering of Horse-Chestnut, 574
  Letters received from Dr. N. Tinbergen, of Leyden, and Dr. A. Buzzati-Traverso, of Pallanza, 576
Hymas, F. C., and others : Efficacy of D.D.T. in Soap, 749

IMMS, Dr. A D. : Retirement from the readership in entomology in the Department of Zoology, Cambridge, 712 , work of, 712
Imperial Agricultural Bureaux . Joint Publication No. 7 on *Imperata cylindrica*, 342
Imperial Cancer Research Fund : Forty-second Annual Report for 1944–1945, 343
Imperial Chemical Industries, Ltd. : Fellowships at Cambridge, 17
  Offer to the University of Leeds to finance and support research on the behaviour of gases, 659
I.C.I. (India) : Offer to the National Institute of Sciences of India of 336,000 rupees for research fellowships in chemistry, physics and biology, 107
Imperial College of Science and Technology · Appointment of A. L. L. Baker to the University of London chair of concrete technology, 45
  Title of University of London reader in analytical chemistry conferred on L. S. Theobald, 566
  Appointment of Prof D. M. Newitt to the Courtaulds chair of chemical engineering, 714, 774
  Centenary celebrations of the, 264, 518
    Address by H.M. the King, 518
    Reply by Dr. R. V. Southwell, 519
    Tributes to the Influence of the Imperial College (Sir Richard Gregory), 519 ; (Dr. W. H. Eccles), 520 ; (Sir William Jarratt), 520
    Introductory Address (Lord Rayleigh), 520
  Contributions of the, to the Conquest of Disease (Lord Rayleigh), 520
  Physics and Astrophysics at the (Prof. Herbert Dingle), 562
  Engineering at the—The City and Guilds College (Prof. E. F. D. Witchell), 650
  The Royal School of Mines—Geology, Mining and Metallurgy at the (Prof. W. R. Jones), 706
Imperial Institute . Series of lectures on recent progress in Geological Investigation and Mineral Developments in the Colonies, 362
Imrie, Dr. C. Gray : Resignation as lecturer in physiology in the University of Sheffield, 79
Indian Statistical Institute : Work of the, 722
Industrial Health Research Board : Appointment of members by the Medical Research Board, 566
Infeld, Prof. L. : A New Approach to Relativistic Cosmology, 114
Ingelman, Bjorn, and Jullander, Ingvar · Preparation of Silicic Acid Jellies for Bacteriological Purposes, 572
Ingold, Prof. C. K. . Near Ultra-Violet Emission Bands of Benzene, 569
Ingold, Prof. C. K., and others : Univalent Electron Transfers in Aromatic Nitration?, 688
Innes (John) Horticultural Institution : To move from Merton to Bayfordbury, 586
  Thirty-fifth Annual Report, 669
Innes, Roy : Appointed general secretary of the Association of Scientific Workers, 331
Institute of Fuel · Elections, 45
  Appointment of R. W. Reynolds-Davies as deputy secretary, 329
Institute of Metals, the Iron and Steel Institute and the Institution of Mining and Metallurgy : To establish, in co-operation with the Ministry of Education, a scheme for National Certificates in Metallurgy, 138
Institute of Physics (London and Home Counties' Branch) : Discussion on the Corrosion of Metals, 435
Institute of Physics, the Institution of Chemical Engineers, and the Chemical Engineering Group of the Society of Chemical Industry Joint conference on Instruments for the Automatic Controlling and Recording of Chemical and other Processes, 45, 723
Institute for the Study of Animal Behaviour : Election of officers, 566
Institute of Welding : Sir William J. Larke Medal for 1945 awarded to W. K. B. Marshall, 473
  Prize awards, 473
Institution of Chemical Engineers, the Institute of Physics and the Chemical Engineering Group of the Society of Chemical Industry : Joint conference on Instruments for the Automatic Controlling and Recording of Chemical and other Processes, 45, 723
Institution of Civil Engineers : Field-Marshal the Hon. Sir Harold Alexander and Sir Edward Appleton elected honorary members, 598
Institution of Electrical Engineers : Award of Premiums, 17
  Election of officers, 108
  Annual Report for the Year 1944–45, 139
Institution of Metallurgists : Inaugural Meeting of the, 710
Institution of Mining and Metallurgy, the Institute of Metals and the Iron and Steel Institute : To establish, in co-operation with the Ministry of Education, a scheme for National Certificates in Metallurgy, 138
Institution of Naval Architects . Appointment of Capt. Arthur Dyce Duckworth as secretary, 502
Institution of the Rubber Industry (Midland Section of the) : Symposium on the Physical and Chemical Breakdown of Rubber, 9
International Council for the Exploration of the Sea : Reconstitution of the, 597
International Wool Secretariat · Grant of £300 a year to the University of Leeds for the establishment of a Wool Research Scholarship, 502
Iron and Steel Institute, the Institution of Mining and Metallurgy and the Institute of Metals : To establish, in co-operation with the Ministry of Education, a scheme for National Certificates in Metallurgy, 138
Iron and Steel Research Association, British : Formation of the, 138
  Appointment of Dr. C F. Goodeve as director, 138, 472
Irving, Prof. J. T. : Effect of Restriction of Food Intake upon the Incisor Teeth of Rachitic Rats, 664
Irwin, Raymond : Appointed director of the School of Librarianship at University College, London, 108, 202

JACKS, G. V. : Soil Erosion in New Zealand, *review*, 703
Jackson, Prof. Willis, and Reddish, W. : High Permittivity Crystalline Aggregates, 717
Jacobs, Dr. Morris B. : The Chemistry and Technology of Food and Food Products, Vol. 2, *review* by Dr. T. Moran, 220
Jacoby, Dr. F. : Differentiation between Eosinophils and Pseudo-eosinophils of Rabbits' Blood by means of a Peroxidase Reaction, 420
James, Dr. Sybil P., and others : A Constitutional Synthesis of Chondrosamine, 308
Jánossy, Dr. L. : Cosmic Rays, 543
  Cosmic Radiation, 704
Jarratt, Sir William : Tribute to the influence of the Imperial College of Science and Technology, 520
Jefferies, Richard : The Wood from the Trees, *review* by Major T. H. Hawkins, 613
Jefferson, G. T. : Heat Injury in Insects, 111
Jefferson's (Thomas) Garden Book, 1766–1824, with Relevant Extracts from his other Writings (annotated by Prof. Edwin Morris Betts), *review* by Dr. E. J. Salisbury, 128
Jeffery, Prof. G. B · Appointed director of the Institute of Education, University of London, 443 ; work of, 443
Jeffrey, Dr. G. A. : Structure of Dibenzyl, 82
Jennings, M A. . Activity of Helvolic Acid against *Mycobacterium tuberculosis*, 633
Joffe, Prof. A., and others : *Obituary* of Prof. L. I. Mandelstam, 105
Johannsen, —. : Atomic Weight of Beryllium, 179
Johnson, Dr. P. : Elected to an Imperial Chemical Industries Fellowship at Cambridge, 17
  Comparison of Enzyme and Immune Reactions, *review*, 517
Joliot-Curie, Mme. . Cosmic Rays, 544
Jones, Dr. Ernest : The Scapegoat in Modern Europe, 381
Jones, E. R. W. (Chalmers, Dr. B., and) : Application of Statistical Methods to Mechanical Test Results, 307
Jones, Prof. F. Wood : *Obituary* of Dr. G. V. Buchanan, 385
Jones, Sir Harold Spencer : Astronomy and Terrestrial Magnetism in the U S S.R., 324
Jones, J. K. N., and others : Application of New Methods of End-Group Determination to Structural Problems in the Polysaccharides, 785
Jones, Prof. Ll. Rodwell · Retirement from the University of London chair of geography at the London School of Economics, 291 ; work of, 291
Jones, T. S. . Unusual State at Birth of a Bat, 365
Jones, Prof. W. R. : Nationalization of Mineral Rights, 667
  The Royal School of Mines—Geology, Mining and Metallurgy at the Imperial College, 706
Jordan, Prof. H. J. : *Death* of, 166
Jullander, Ingvar (Ingelman, Bjorn, and) : Preparation of Silicic Acid Jellies for Bacteriological Purposes, 572
Junk, Dr. W. : Prof. W. Weisbach now the sole owner of the publishing house of, 687
Juricic, Dr. B., and others : Fluorescence Microscopy of Tubercle Bacilli, 16

KANDEL, Prof. I. L. (edited by) : Post-War Educational Reconstruction in the United Nations, *review*, 318
Kanga, Prof D D. : Methods of Research, 777
Kapitza, Prof. P., and others : *Obituary* of Prof. L I. Mandelstam, 105
Kaufmann, Prof. Felix : Methodology of the Social Sciences, *review* by Prof. David Mitrany, 278
Kay, Prof. H. D · The Secretion of Milk, 159
Kekcheyev, Prof. Krikor : Conditioned Excitors and Human Sense Organs, 573
Kemmerer, Dr. E W. : *Death* of, 774
Kemp, Dr Stanley W. : *Obituary* by Dr. N. A. Mackintosh, 41
Kennedy, Dr. J. S. : Classification and Nomenclature of Animal Behaviour, 754
Kenner, Prof. J. · Oxidation and Reduction in Chemistry, 369
Kent, J , and Heatley, N G. · Antibiotics from Moulds, 295
Kent-Jones, Dr. D. W., and Amos, Dr. A. J. : Bread in Jersey during German Occupation, 336
Kernot, Dr. J. C. : *Death* of, 106
Keys, Prof. David A. : Appointed a member of the National Research Council of Canada, 416
Kidd, W., and McWhirter, E. M. S. Operational Control of Electricity Supply Systems, 361
Kift, A. A. , Retirement from Marconi's Wireless Telegraph Company, 329 ; work of, 329
Killick, Prof. Esther M. : Appointed a member of the Industrial Health Research Board of the Medical Research Council, 566
King, H.M. the : Address to the Imperial College of Science and Technology, 518
King Edward's Hospital Fund for London : Second Memorandum on Hospital Diet, 725
King, A. J. : Difference Tones, 536
King, F. G. W. : Physical and Chemical Breakdown of Rubber, 9
King, Dr. J. D. : Enamel Cuticle (Nasmyth's Membrane) and Tartar Deposition in the Ferret, 572
King, Dr. J. Leycester : Social Psychiatry, *review*, 279
King's College, London : Appointment of Dr. D. H. Hey to the University of London chair of chemistry, 108, 140
  Appointment of Dr. James Greig to the University of London chair of electrical engineering, 660
King's College, Newcastle-upon-Tyne : Appointment of G. H. Forsyth to the chair of mechanical and marine engineering, 140
King's College of Household and Social Science : Appointment of Dr. John Yudkin to the University of London chair of physiology, 202, 471
  Title of University of London reader in nutritional science conferred on Dr. Gladys A. Hartwell, 566
King's College Observatory, Aberdeen : Earthquakes registered during the First Quarter of 1945, 264
  Earthquakes registered during April, May and June, 545
Kinnear, N. B. : Appointed keeper in the Department of Zoology of the British Museum (Natural History), 17
  Obituary of Dr. Frank Chapman, 741
Kirwan, Lieut.-Colonel L. P. : Appointed secretary of the Royal Geographical Society, 445
Klissiunis, N. : Effect of Sulphanilamide on the Sugar Consumption of *Bact. coli*, 178
Knight, Dr. B. C. J. G : Growth-Factors and Growth Inhibitors for Micro-organisms, 86
Knoche, Dr W. : *Obituary* by Dr. Otto Schneider, 328
Kodicek, Dr. E. (Harris, Dr. L. J., and) : The Vitamin B_2 Complex, 86
Kolossov, —. . Chalk-washing of Sugar-Beet in Dry Climates, 304
Kravkov, Prof. S. V., and Galotchkina, L. P. : Electrotonus in Colour Vision, *erratum*, 626
Krebs, Prof. H. A. : Message received from Dr. T. Bücher concerning Prof. Otto Warburg, 714
Krishnan, Prof. K. S., and Bhatia, A. B. : Electrical Resistance of Liquid Metals, 503
Krishnan, Dr. R S. : Raman and Infra-red Spectra of Rock-salt, 267
Krogh, Prof. August The Active and Passive Exchanges of Inorganic Ions through the Surfaces of Living Cells and through Living Membranes Generally, 542
Krogh, Prof. S. A. S. : Awarded the Baly Medal of the Royal College of Physicians, 531
Kuloor, N. R. (Newitt, Prof. D. M., and) : Steam Tables and Steam Power, 755
Kupalov, Prof. P. S. : Research on Conditioned Reflexes, 455

LABOUR Legislation, British Association for : The New I.L.O., 231
Labour and National Service, Ministry of : Technical and Scientific Register of the, 502
Lack, David, and Varley, G. C. : Detection of Birds by Radar, 446
Lacroix, Prof. P. : Recent Investigations on the Growth of Bone, 576
Ladewig, Dr. Peter : Double-Refringence of the Amyloid-Congo-Red-Complex in Histological Sections, 81
Laki, Dr. K., and Mommaerts, Dr. W. F. H. M. : Transition of Fibrinogen to Fibrin as a Two-Step Reaction, 664
Lamb, Prof. E. H. : Retirement from the chair of civil and mechanical engineering at Queen Mary College, London, 137 ; work of, 137
Lambrechts, A., and others : Les états de carence en Belgique pendant l'occupation Allemande 1940–1944, *review* by Major J. Marshall, 551
Lamont, Lieut.-Colonel J. C. : *Death* of, 106
Lampitt, Dr. L. H. : Visit to Paris to re-establish contact with French men of science, 473
Lancaster-Jones, E. : *Obituary* by Dr. H. Shaw, 442
Landon, Prof. F. : Awarded the Tyrell Medal of the Royal Society of Canada, 271
Landsteiner, Dr. Karl : The Specificity of Serological Reactions, revised edition, *review* by Capt. J. A. R. Miles, 348
Lane, Frank W. : The Elements Rage, *review*, 703
Lane, J. H. : Appointed editor of *The Analyst*, 443
Lane, Prof. R. E. : Appointed a member of the Industrial Health Research Board of the Medical Research Council, 566
Langdon-Davies, John : British Achievement in the Art of Healing, *review* by Dr. G. Lapage, 350
Lapage, Dr. G. : Historical Library of Yale University School of Medicine, 27
  British Army Veterinary Services in the Far East, 60
  Some British Work on Nutrition, 123
  Health Research in Industry, 148
  Uses and Limitations of Penicillin, 244
  Mode of Action of Penicillin, 272
  A Medium for Mounting Parasitic Helminths, 298
  Achievement in Medical Science, *review*, 350
  Two New Antibiotics, 398
  Tyroglyphid Mites and Human Disease, 427
  Medicine and the Humanities, *review*, 488
  Hospital Diet, 725
  Obituary of Dr. H. E. Durham, 742
  Science and Mysticism, *review*, 763
Laser, Dr. H., and Friedmann, Dr. E. : Crystalline Hæmolytic Substance from Normal Blood, 507
Lashley, Karl Spencer : Awarded the Daniel Giraud Elliot Medal for 1943 of the United States National Academy of Sciences, 575
Lasnitzki, Dr. A. : Cell Proliferation, Carbohydrate Breakdown and Hydration of Enzyme Protein, 398
Latimer, G. E. M. : Appointed veterinary officer, Nigeria, 697
Laurie, Prof. R. D. : Some Comparisons between Universities, 183
Lea, A. J. : A Neutral Solvent for Melanin, 478
League of Nations : Report on Pre-War Production and Distribution of Narcotic Drugs and their Raw Materials (L F. Atzenweiler), 361
Leakey, Dr. J. B. S., and Owen, Archdeacon : A Contribution to the Study of the Tumbian Culture in East Africa, 371
Leakey, Mary D. : Report on the Excavations at Hyrax Hill, Nakuru, Kenya Colony, 1937–1938, 722
Lebesgue, Prof. Henri : Les coniques, *review* by Prof. H. T. H. Piaggio, 648
LeBrocq, L. F., and Cocks, H C. : Hydrogen Overvoltage as a Factor in the Corrosion of Metallic Couples, 536
Lecoin, —. : Cosmic Rays, 544
Lee, Dr. S. W., and others : 'Fissibactericidal' Nature of Penicillin Action, 49
Lees, Dr. A. : *Obituary* by Prof. H. T. H Piaggio, 499
Leftwich, H. S. : Packing of Regular (Spherical) and Irregular Particles, 753
Leibowitz, Dr. J., and others : Production of Extracellular Starch in Cultures of Capsulated Yeasts, 295
Lemery, Nicolas (1645–1715) : 598
Leningrad Society of Naturalists : To resume activities at the State University of Leningrad, 293
Lennard-Jones, Prof. J. E. : Appointed chief scientific officer to the Ministry of Supply, 168
Lennox, F. G., and others : Fundamental Investigations on the Fellmongering Process, 483
Leroux, Dr. Hélène (Bezssonoff, Dr. N., and) : Vitamin C Peroxidasic Activity, 474
Levan, Albert : Cytological Reactions induced by Inorganic Salt Solutions, 751
Lever, R. A : 'Palolo' Worms in Pacific Waters, 19
Lever Brothers and Unilever, Ltd. : Appointment of Dr. H. J. Gough as engineer-in-chief, 202, 290
Leverhulme Trustees : Grant to enable Prof. Whytlaw-Gray to devote himself to research, 659
Levine, Dr. Philip : Anti-*Hr* Sera, 418
Lewis, Brigadier Sir Clinton : *Obituary* of Colonel C. H. D. Ryder, 326
Lewis, Prof. F. J. : Physical Conditions of the Surface of the Mesophyll Cell Walls of the Leaf, 407
  A Flora of Familiar English Plants, *review*, 461
  Plant Life and Solar Energy, *review*, 487
  Forestry Problems in the United States, *review*, 584
Lewis and Co., Ltd., H. K. : Considering the addition of foreign medical and scientific books to their lending library, 566
Leyton, Dr. L. : Appointed tree physiologist in the Department of Forestry of the University of Oxford, 293
Li, Dr. Fei-pai, and Yang, Fu-hsi : A Medium for Mounting Parasitic Helminths, 297
Library Association : Conference on University and Research Libraries, 417
Liddel, Urner, and others : Infra-red Spectroscopy, *review* by Dr. H. W. Thompson, 65
Lidwell, O. M. : Production of Skin Burns by Hot Gases, 298
Lightfoot, Gerald : Retirement from the secretaryship of the Australian Council for Scientific and Industrial Research, 444 ; work of, 444
Limaye, V. D. : The Testing of Indian Plywood Tea Chests, 668
Lindsay, Dr. A. D. . Wilhelm Dilthey, *review*, 461
  The Good and the Clever, 744
Lindstedt, Gosta : Periodate Oxidation of Sugars in Neutral Phosphate Buffer, 448
Linnaeus : A Recently Discovered Manuscript by (Dr. Anders Grape), 351
Linnean Society : Meeting to celebrate the eightieth birthday of Prof. F. E. Weiss, 500
Linstead, Prof. R. P . Appointed director of the Chemical Research Laboratory, Teddington, 415 ; work of, 415
Linton, Squadron-Leader David L. : Appointed to the chair of geography at the University of Sheffield, 106 ; work of, 106
Lipschutz, Prof. Dr. Alejandro : El Indoamericanismo y el Problema Racial en las Américas, segunda edicion, *review* by Prof. A. R. Radcliffe-Brown, 158
Lipson, Dr. H. : Appointed head of the Department of Physics in the Manchester College of Technology, 533
Lipson, M. : Frictional Properties of Wool Fibres, 268
Lissmann, H. W. : Histological Fixation of Locomotory Patterns, 391
Lloyd, Dr. D. Jordan : Scientific Study of Fellmongering, 483
Lochner, R. A. : Microfilm and other Means of Documentary Reproduction, 26
Loewenfeld, Dr. Margaret : The Scapegoat in Modern Europe, 381
London Museum : Appointment of W. F. Grimes as keeper and secretary, 660
London Natural History Society : Retirement of A. B. Hornblower as honorary general secretary, 108
  Appointment of H. A. Toombs as honorary general secretary, 108

London School of Economics : Appointment of Dr. F. C. Benham to the University of London chair of commerce, 108
  Appointment of Dr. A I. Richards to the University of London readership in anthropology, 533
  Retirement of Prof. Ll. Rodwell Jones from the University of London chair of geography, 291
  Appointment of Dr L Dudley Stamp to the University of London chair of geography, 202, 291
London School of Hygiene and Tropical Medicine : Retirement of Prof. Major Greenwood from the University of London chair of epidemiology and vital statistics, 43
  Title of reader in bacteriology in the University of London conferred on J. C. Cruickshank, 108
  Appointment of Dr. Kenneth Mellanby to the University of London readership in entomology, 712
Lopez, Dr. E. Vazquez : Glioma in a Rat Fed with 2-Acetyl-amino-fluorene, 296
Lovelock, J. E. : Aerial Bactericides, 782
Lowy, Dr Samuel : Man and his Fellowmen, *review* by Dr J. Leycester King, 279
Lucas, A. : *Death* of, 742
Ludford, Dr. R. J. . *Obituary* of Dr. William Cramer, 773
Luria, S. E. : Mutations *in* Bacterial Virus, 304
Luyten, Dr. W. J. : First discovery of White Dwarf Binaries, 293
Lynch, Sr. Eva Maria (Nutini, Dr Leo G., and) . Effect of Tissue Extracts in controlling *Staphylococcus aureus* Infections, 419

MAASS, Dr. Otto : Awarded the Henry Marshal Tory Medal of the Royal Society of Canada, 271
Maberly, Dr Alan : Child Guidance Grows Up, *review*, 157
Macaulay Institute for Soil Research : Leave of absence granted to Dr. A. B. Stewart to advise the Government of India on soil fertility and crop production, 566
Macbeth, Prof A. Killen, and Rodda, Harold J. Amino-quinazolines, 207
Macbeth, Prof. A. Killen (Berry, P. A., and) : A Tetrabromide of β-Phellandrene, 175
McCrea, Prof. W. H. : New Views of the Origin of the Solar System, 466
McCulloch, Dr. W. E., and colleagues : Report on Nutrition and Agriculture in Jamaica, 288
McCusker, C. B. A. (Rochester, Dr. G D , and) : Effect of the Pressure of Alcohol Vapour on the Operation of the Fast Geiger-Muller Counter, 366
MacDonnell, Eithne (Conway, Prof. Edward J , and) : Carboxylase and Carbonic Acid, 752
McGowan, J. C. (Brian, Dr. P. W., and) : Viridin, a Highly Fungistatic Substance produced by *Trichoderma viride*, 144
Macgregor, Dr. Murray : Retirement as director of the Geological Survey (Scottish Office), 743 ; work of, 743
McIlwaine, Dr. H. : Appointed lecturer in biochemistry in the University of Sheffield, 745
MacKain, J. Corston : Awarded a second prize by the Institute of Welding, 473
McKay, Lieut. H. A. C. : Detection of Birds by Radar, 629
McKay, Robert, and Clinch, Dr. Phyllis E. M. : Frost Injury Simulating Virus Disease Symptoms on Potato Foliage, 449
MacKeith, Surgeon Lieut-Comdr. R. C. : The Film in Medicine, 426
Mackenzie, Dr. : Biochemical Aspects of Mental Disorder, 103
McKenzie, Prof. Alex. : *Obituary* of Prof. Marc Tiffeneau, 656
McKenzie, Dr. C. J. : Post-War Planning for Scientific Research in Canada, 500
Mackintosh, Colonel E. E. B. : Retirement from the directorship of the Science Museum, 626, 658 ; work of, 658
Mackintosh, Prof. J. M. . Appointed a member of the Industrial Health Research Board of the Medical Research Council, 566
Mackintosh, Dr. N. A. : *Obituary* of Dr. Stanley W. Kemp, 41
McLean, D. A. : Chemically Stabilized Paper Capacitors, 455
McLintock, Dr W. F. P. : Appointed director of the Geological Survey of Great Britain, 168, 329 ; work of, 329
McManus, Major J F. A. : Granules of the Human Polymorphonuclear Leucocyte, 173
McNally, Dr. P A (Barry, Vincent C., and) Inhibitory Action of Dialkyl Succinic Acid Derivatives on the Growth *in vitro* of Acid-fast Bacteria, 48
MacNaughtan, Mrs. Jean (Challinor, Dr. S W , and) : Concentration of Solutions of Salts of Penicillin, 602
McWhirter, E. M S. (Kidd, W., and) : Operational Control of Electricity Supply Systems, 361
Madditon, J. . Teaching by means of the Scientific Film, 57
Madhok, Dr. M. R., and Fazal-Uddin . Losses of Nitrous Nitrogen from Soils on Desiccation, 49
Magat, Michael (Talalay, Anselm, and) : *Synthetic Rubber from Alcohol*, *review* by Dr. W. J. S. Naunton, 251
Magendie, François (1783–1855), *review* by Prof E. D. Adrian, 316
Mager, J., and others . Production of Extracellular Starch in Cultures of Capsulated Yeasts, 295
Maher, A. C. : Appointed senior soil conservation officer, Kenya, 264
Maheshwari, Dr P. : An Endodermal Phellogen in the Stem of *Paederia foetida* Linn., 116
  Origin of Haploid-Diploid Twin Embryos in Angiosperms, 173
  Embryology of Angiosperms as a Field for Research, 354
Maidment, W. T. O. : Appointed senior agricultural officer, Uganda, 445
Majumdar, D. N., and others (edited by) . *Essays in Anthropology Presented to Rai Bahadur Sarat Chandra Roy*, *review* by Prof. J. H. Hutton, 66
Majumdar, S. K., and others : X-Ray Study of the Solution of Alkali Halides in Borax and B_2O_3 Glass Systems, 423
Makower, Prof. W. : *Death* of, 106 ; *obituary*, 385
Malinowski, Bronislaw : A Scientific Theory of Culture, and other Essays, *review* by Dr C. S. Myers, 218
Malm, Mignon . A Colour Reaction in Yeast, 52
Manchester College of Technology : Appointment of Dr. H. Lipson as head of the Department of Physics, 533
Mandelstam, Prof. L. I. : *Obituary* by Prof. P. Kapitza, Prof. A. Joffe and Prof. S. Vavilov, 105
Manley, R. G. : Waveform Analysis, *review* by Dr. L. E C Hughes, 765
Mann, Dr. T. : Anærobic Metabolism of Spermatozoa, 80
Mann, T. Barton, and Seaber, W. M. . Determination of β-Carotene In Dried Grass, 571
Mannheim, Dr. Karl : Appointed to the University of London chair of education at the Institute of Education, 714, 743
Manton, Dr. Irene . Appointed to the chair of botany in the University of Leeds, 108, 230 ; work of, 230
Manton, Dr. S. M. : South African Onychophora, 338
Marconi's Wireless Telegraph Company : Retirement of A A. Kift, 329
Maree, B. D. : Structure of the Vredefort 'Dome', 304
Marine Biological Association . Appointment of F. S Russell as director of the Laboratory at Plymouth, 76
Marine Biological Association, Scottish : Annual Reports for 1938–39 to 1943–44, 668
Markwick, A. H. D : Particle Shape, 177
Marlio, Dr. Louis (Moulton, Dr. Harold G., and) : The Control of Germany and Japan, 64
Marshall, C. F. Dendy : *Death* of, 471
Marshall, C W. : Electricity Supply Organisation, *review*, 585
Marshall, Dr. F. H A , and Halnan, E. T . Physiology of Farm Animals, third edition, *review* by Dr. John Hammond, 377
Marshall, Major James . Cervico-Facial Pigmentation (Melanosis of Riehl-Poikiloderma), (Dr. Georges Garnier), *translation*, 163 .
  Relation of the Gonadal Hormones to certain Dermatoses (Dr. Georges Garner), *translation*, 339
  Deficiency Diseases in Belgium, *review*, 551
  Penicillin in the Treatment of Syphilis, 769
Marshall, John F. : Records of *Culex* (*Barraudius*) *modestus* Ficalbi (Diptera, Culicidæ) obtained in the South of England, 172
Marshall, P. B. : Loss of Antimalarial Properties in Quinine Degradation Products, 505
Marshall, W. K. B. : Awarded the Sir William J. Larke Medal of the Institute of Welding for 1945, and a first prize of £50, 473
Martin, H , and Wain, R. L. . Phytopathological Uses of the new Insecticide D D.T., 168
Mason, S E. (Hammick, D. Ll., and) : Primary Degradation Products of Mepacrine in Human Urines, 718
Maxcy, Dr. Kenneth F. : Awarded the United States Typhus Commission Medal, 445
Maxwell, Margaret, and others : Fundamental Investigations on the Fellmongering Process, 483
May, W. E : Repeating Compasses, 593
Mayer, Dr Fritz . The Chemistry of Natural Colouring Matters, translated and revised by Dr A. H Cook, *review* by Prof W. Baker, 552
Maze, M. : Cosmic Rays, 543
Medical Academy of the U S.S.R. : Election of first members, 714
Medical Association, British (Nutritional Committee of the Jamaica Branch) : Report on Nutrition and Agriculture In Jamaica (Dr. W. E. McCulloch and colleagues), 288
Medical Research, Committee on (Washington), and the Medical Research Council (London) : Chemistry of Penicillin, 766
Medical Research Council : Resumption of Rockefeller Medical Fellowships, 17
  Report on Health Research in Industry, 148
  War-time Memorandum on Nutritive Values of War-time Foods, 330
  War Memorandum No. 13, Arterial *Injuries*, 362
  Appointment of Prof. P A. Buxton and Sir Alexander Fleming as members, 362
  Appointment of members to the Industrial Health Research Board, 566
Medical Research Council (London), and the Committee on Medical Research (Washington) : Chemistry of Penicillin, 766
Medicine, Royal Society of (Psychiatry Section) : Meeting on the Biochemistry of Mental Disorder, 101
Medicine, Royal Society of, in co-operation with the Scientific Film Association : To prepare a catalogue of Medical Films in Great Britain, 387
Meek, Dr. J. M., and Waterton, F. W. : Measurement of High Voltages, 422
Meek, Dr J. M. (Craggs, Dr. J. D., and) . Afterglow Effects in High-Pressure Gases, 21
Mehta, G. K., and others : Splitting of the Sodium Doublet Lines, 662
Mellanby, Dr. Kenneth : Appointed to the University of London readership in entomology at the London School of Hygiene and Tropical Medicine, 712
Mellon Institute of Industrial Research : Thirty-second Annual Report, 541
Melville, Prof. H W. : The Mechanism of Polymerization of Vinyl Compounds, 639
Melville, Prof H. W. (Burnett, G. M , and) Propagation and Termination Coefficients for Vinyl Acetate Photopolymerization, 661
Mendeléeff : Tribute to, in connexion with the seventy-fifth anniversary of the discovery of the Periodic Law (M. Pervukhim), 331
Menkart, J., and Speakman, Prof J. B : Scaliness of Wool Fibres, 143
Menzies, A. (Stoy, R. H., and) : Re-Observation of the Magnitudes of the Southern Comparison Stars for Eros, 179
Menzies, Group-Captain A. C. . Appointed controller of research and development to Adam Hilger, Ltd., 624
Merewether, Dr. E R. A. Appointed a member of the Industrial Health Research Board of the Medical Research Council, 566
Merriam, Dr. J C. : *Obituary* by Prof D. M. S Watson, 683
Merrill, Paul W. : Awarded the Henry Draper Medal for 1945 of the United States National Academy of Sciences, 575
Metallurgists, Institution of : Inaugural Meeting of the, 710
Metals, Institute of, the Iron and Steel Institute and the Institution of Mining and Metallurgy : To establish, in co-operation with the Ministry of Education, a scheme for National Certificates in Metallurgy, 138
Meyer, Dr Gustave M. : *Death* of, 199
Meyer, Prof. Martin : The Science of Explosives, *review* by Prof John Read, 5
Middlemiss, C. S. : *Obituary* by Sir Lewis Fermor, 594
Miles, Capt. J. A. R. : Antigens and Antibodies, *review*, 348
Miller, Alden H. (Grinnell, Joseph, and) . The Distribution of the Birds of California, *review*, 34
Miller, Neal E., and Dollard, John : Social Learning and Imitation, *review* by Dr. John Cohen, 515
Millport Marine Laboratory : Research Work at the, 668

Mills, J. P., and others (edited by): Essays in Anthropology Presented to Rai Bahadur Sarat Chandra Roy, *review* by Prof. J. H. Hutton, 66
Milne, Prof. E. A.: Kinematical Relativity, 747
Milne-Thomson, Prof. L. M: Bessel Functions, *review*, 190
Milne-Watson, Sir David: *Death* of, 443; *obituary* by Dr. E. F. Armstrong, 499
Milsom, F.: *Death* of, 742
Mines, Royal School of—Geology, Mining and Metallurgy at the Imperial College (Prof. W. R. Jones), 706
Mining and Metallurgy, Institution of, the Institute of Metals and the Iron and Steel Institute: To establish, in co-operation with the Ministry of Education, a scheme for National Certificates in Metallurgy, 138
Ministry of Agriculture and Fisheries: Advisory Leaflet No. 315 on Weed Control in Cereals, 330
  Retirement of Dr E. S. Russell from the post of director of fishery investigations, 687
  Appointment of R. R. Enfield as chief economic adviser, 687
  Appointment of D A. E. Harkness as principal assistant secretary in charge of the Economics and Statistics Division, 687
Ministry of Education: Report on Higher Technological Education, 699
Ministry of Education (Iron and Steel Institute, the Institution of Mining and Metallurgy and the Institute of Metals, in co-operation with the): To establish a scheme for National Certificates in Metallurgy, 138
Ministry of Labour and National Service: Technical and Scientific Register of the, 502
Ministry of Supply: Release of Dr H. J. Gough, 168
  Appointment of Prof. J. E. Lennard-Jones as chief scientific officer, 168
Ministry of Town and Country Planning. National Maps of Britain, 776
Minkoff, G. J., and others: Univalent Electron Transfers in Aromatic Nitration I, 688
Minorsky, Prof. V.: *Obituary* of Brigadier-General Sir Percy Sykes, 104
Mirsky, L.: Appointed assistant lecturer in mathematics in the University of Sheffield, 473
Mitchell, Dr. C. Ainsworth: Retirement from the editorship of *The Analyst*, 443; work of, 443
Mitchell, Sir Peter Chalmers: *Death* of, 15; *obituary* by Dr. Edward Hindle, 103
Mitchell, R. L. (Wager, Prof. L. R., and): Distribution of Vanadium, Chromium, Cobalt and Nickel in Eruptive Rocks, 207
Mitrany, Prof. David: Method in Social Studies, *review*, 278
Moberg, Erik G. (Graham, Herbert W., and). Chemical Results of the last Cruise of the *Carnegie*, 341
Moholy, Mrs. L.: Microfilm and other Means of Documentary Reproduction, 24
Mohr, Prof. Dr. E. C. Jul.: The Soils of Equatorial Regions, with special reference to the Netherlands' East Indies, translated from the Nederlandsch by Robert L. Pendleton, *review* by Dr. A. Muir, 93
Mommaerts, Dr. W. F. H. M.: Molecular Morphology of Myosin, 631
Mommaerts, Dr. W. F. H. M. (Laki, Dr K., and): Transition of Fibrinogen to Fibrin as a Two-Step Reaction, 664
Moncrieff, Dr. Alan. Appointed to the Nuffield chair of child health at the University of London Institute of Child Health, 714
Moore, Prof. E. S.: Elected president of the Royal Society of Canada for 1945–46, 272
Moore, P. T. (Conway, Prof E. J., and). Cation and Anion Permeability Constants for the Muscle Fibre Membrane, 170
  Rate of Entrance of Ammonia into Muscle Fibres in relation to Carbon Dioxide Tension, 270
Moore, W. C.: Cereal Diseases, 533
Moran, Dr. T.: Food Science, *review*, 220
More, Prof. J. A.: *Obituary* of Prof. Ernest Shearer, 470
Morgan, Dr. A. E.: Appointed educational director of the British Council, 77
Morgan, Dr. W. T. J., and others: Enhancement of the Action of Immune Hæm-Agglutinins by Human Serum, 663
Morris, C. J. O. R. (Hoch, H., and): Heterogeneity of Human Serum Albumin, 234
Morris, Dr. H. P.: Mammary Tumours in Mice, 787
Morris, Phillip: Appointed vice-chancellor of the University of Bristol, 659; work of, 659
Morrison, Herbert. Government Support for Research Associations in Britain, 597
Mossman, Prof. H. W., and others: Human Embryology, *review* by Dr. D. V. Davies, 315
Mott, Prof. N. F.: Cosmic Rays, 543
Mottram, Dr J. C.: *Death* of, 443
Mottram, Prof. V. H.. The Physical Basis of Personality, *review* by Dr. G. Lapage, 763
Motz, Dr. H.: Appointed lecturer in engineering physics in the University of Sheffield, 79
Moulton, Dr. Harold G., and Marlio, Dr. Louis: The Control of Germany and Japan, 64
Muir, Dr. A.: Tropical Pedology, *review*, 93
  Pedology in the U.S.S.R., 258
Munroe, Helen: Classified List of Smithsonian Publications Available for Distribution, 362
Murgatroyd, J. B., and Sykes, R. F.: Mechanism of Brittle Rupture, 716
Murneek, A. E.: Biennial Bearing of Apple Trees, 304
Murray, Dr. M A.: The Scapegoat in Modern Europe, 381
Museum Book Store, Ltd.: Library of the late Prof. Hans Sachs acquired by the, 264
Muskett, A. E., and Colhoun, J.. Control of Foot Rot (*Phoma* sp.) of Flax, 538
Myers, Dr. C S.: The Posthumous Testimony of an Anthropologist, *review*, 218

NARAYANAMURTI, D., and Singh, Kartar: Preliminary Studies on Improved Wood, Part 3, Compregnated Wood, 787
Nash, A. S.: The University in the Modern World, 184
National Cancer Institute: To compile and publish all data relative to Cancer Therapy, 387
  (Members of the Staff of the): Mammary Tumours in Mice, 787
National Institute of Agricultural Engineering: Publication of No 1 of the *Agricultural Engineering Record*, 232, 500
National Institute of Sciences of India: Offer by I.C.I. (India) of 336,000 rupees for research fellowships in chemistry, physics and biology, 107
National Parks Committee: Appointed by the Minister of Town and Country Planning, 108
National Research Council of Canada. Awards for Postgraduate Training, 201
  Appointment of members, 416
  Annual Report for 1943–44, 500
  Post-War Planning for Scientific Research, 500
Nations, League of. Report on Pre-War Production and Distribution of Narcotic Drugs and their Raw Materials (L. F. Atzenweiler), 361
Nature Reserves, Society for the Promotion of: Report by the Geological Sub-Committee of the Nature Reserves Investigation Committee on National Geological Reserves in England and Wales, 485
Naunton, Dr. W. J. S.: Synthetic Rubber from Alcohol, *review*, 251
Naylor, G. F. K.: Estimation of Multiple Correlation by means of Stereographic Projection, 58
Neale, Dr. S. M.: A Convenient 'Bridge' for Two-Solution Cells, 506
Needham, Dr Joseph: Science in Kweichow and Kuangsi, 496
  A United Nations Educational and Cultural Organisation—The Place of Science and International Scientific Co-operation in Post-War World Organisation, 558
Neish, W. J P, and Speakman, Prof. J. B.: Unshrinkable Wool, 176
Němec, Prof. Bohumil. Plant Life, 416
  The Green Kingdom, 416
Neuprez, R, and others: Les états de carence en Belgique pendant l'occupation Allemande 1940–1944, *review* by Major J. Marshall, 551
New York Academy of Medicine: Interim Report of the Committee on Medicine and the Changing Order, 341
New Zealand Geographical Society: Issue of the *New Zealand Geographer*, 44
New Zealand State Forest Service: Annual Report for 1944, 292
Newcomen Society: Jubilee of the, 416
  Annual General Meeting and Jubilee Dinner, 757
  Re-election of S. B. Hamilton as president, 758
Newitt, Prof. D. M.: Appointed to the Courtaulds chair of chemical engineering at the Imperial College of Science and Technology, 714, 774; work of, 774
Newitt, Prof. D. M, and Kuloor, N. R.: Steam Tables and Steam Power, 755
Newton, Isaac. A Hitherto Unpublished Letter of, 193
Newton, Dr. Robert: Presidential Address to Section V of the Royal Society of Canada, 272
Newton, Dr. R. G.: The Mechanism of Exposure Cracking, 10
Nicholas, D. J. D., and others: Determination of Factors Injurious to Plants in Acid Soils, 778
Nichols, Dr J. E.: Practice and Science in the Sheep Industry, *review*, 251
  The British Pig-raising Industry, 454
Nicholson, Prof. G. W. de P.: Title of professor emeritus in morbid anatomy in the University of London conferred on, 714
Nielsen, E. S.: Untersuchungen uber die Verbreitung, Biologie und Variation der Ceratien im sudlichen Stillen Ozean, 181
Nissan, Dr. A. H. (Grunberg, L., and): Viscosity of Ordinary Liquids at High Rates of Shear, 241
  Degree of Association of Water from the Energy of Viscosity and the Work of Cohesion, 335
Nizet, A., and others: Les états de carence en Belgique pendant l'occupation Allemande 1940–1944, *review* by Major J. Marshall, 551
Noakes, G. R.: A Text-Book of Heat, *review*, 377
Noble, Mary, and others: Blind Seed Disease of Rye-grass, 178
Nord, F. F., and Werkman, C. H. (edited by): Advances in Enzymology and related Subjects of Biochemistry, Vols. 4 and 5, *review* by Dr. J. H. Quastel, 611
Nubling, E.: Display and Bower Building in Bower Birds, 168
Nuffield Foundation: Grant for a special research fellowship for Dr. E. Orowan, 202
  Grants for the promotion of dental teaching and research in Great Britain, 417
Nuffield Trust: Grant of £10,000 to the University of Leeds to establish a readership or senior lectureship in the Dental School, 502
Nunn, Sir Percy: Education, its Data and First Principles, third edition, *review* by T. Raymont, 676
Nursery and Market Garden Industries' Development Society, Ltd.: Twenty-ninth Annual Report, 88
Nutini, Dr. Leo G., and Lynch, Sr. Eva Maria: Effect of Tissue Extracts in controlling *Staphylococcus aureus* Infections, 419
Nutman, Dr. P. S.: A Factor in Clover Nodule Formation associated with the Volume of the Medium Occupied by the Roots, 20
Nutrition Society: Conference on the Training, Qualifications and Function of Dietitians, 566
Nutrition Society and the Biochemical Society: Joint meeting on the Vitamin B_1 Complex, 86

OATES, F.: *Death* of, 15
O'Connor, A. D. (Sorsby, Prof. Arnold, and): Measurement of the Diameters of the Living Eye by means of X-Rays, 779
Offord, Dr. A. C.: Appointed to the chair of mathematics in the Newcastle Division of the University of Durham, 202
Offord, A. C., and Weiss, Dr. J.: Chromatography of Two Solutes, 570
Ogg, Dr. W. G.: Some Aspects of the Work at Rothamsted, 211
Oil and Colour Chemists' Association: Fifth series of postgraduate lectures, 264
  (Manchester Section) and the British Rheologists' Club: Discussion on the General Rheological Properties of Suspensions, 745
O'Kelly, Mrs. Seán T.: Work of, 76
Oliver, Dr. W. R. B.: New Zealand Museums, 165
Olmsted, J. M. D.: François Magendie—Pioneer in Experimental Physiology and Scientific Medicine in Nineteenth Century France, *review* by Prof. E. D. Adrian, 316
Omer-Cooper, Prof. J, and Whitnall, A. B. M.: An Arsenic-Resistant Tick, 450

Op de Beeck, M.-J., and others : Les états de carence en Belgique pendant l'occupation Allemande 1940–1944, *review* by Major J. Marshall, 551
Opie, Prof. Eugene L. : Awarded the Weber-Parkes Prize and Medal of the Royal College of Physicians, 531
Oram, A. T : A Theory of Telepathy, 303
Orowan, Dr. E. : Grant from the Nuffield Foundation for a special research fellowship, 202
  Strength of Materials, 307
Orr, Sir John Boyd : If I were Minister of Food in Peace-time, 292
  Elected rector of the University of Glasgow, 502
  Appointed the first director-general of the United Nations Food and Agricultural Organisation, 533
Orr, Dr. W. J. C., and Bolland, J. L : Thermal Breakdown of Rubber, 9
Orton, Prof J. H. : Utilization of the Slipper-Limpet (*Crepidula fornicata*) as Food as an Aid to the Recovery of Oyster-Culture in the Thames Estuary, 665
Orwin, Dr C S. : Retirement from the Agricultural Economics Research Institute, Oxford, 500
Östland, E. (Euler, Prof U. S. v, and): An Undialysable Pressor Principle in Organ Extracts, 49
Ottaway, Christopher W. : Awarded a senior Wellcome Fellowship for Veterinary Research, 45
Ottesen, J. (Hevesy, Prof. G., and) : Life-Cycle of the Red Corpuscles of the Hen, 534
Owen, Archdeacon (Leakey, Dr. J. B. S, and) : A Contribution to the Study of the Tumbian Culture in East Africa, 371

PADGWICK, G. W : Degree of D Sc. of the University of London conferred on, 108
Padhye, M. R (Asundi, Prof. R. K, and) : Near Ultra-Violet Emission Bands of Benzene, 368
Pagel, Dr. Walter : Jewish Physicians through History, *review*, 31
Paget, Sir Richard : Is Human Speech Good Enough ?, 209
Pais, Dr. A. : Life-time of the Neutral Meson, 715
Palæontographical Society : Publication of a Directory of British Fossiliferous Localities, 168
Palin, D. E., and Powell, H. M. : Hydrogen Bond Linking of Quinol Molecules, 334
Parker, Audrey M. B : Unit Cell and Space-Group of Co_2-Al_9, 783
Parkin, E. A., and Green, A. A. : Toxicity of D D.T. to the Housefly, 745
Parkinson, Dr. D., and Bloxham, J L. : The Behaviour of Natural Rubber and GR-S under Repeated Stress Cycles, 11
Parks Committee, National : Appointed by the Minister of Town and Country Planning, 108
Parshad, R. : Measurement of Ultrasonic Velocities in Extended Solids, 637
Parson, Alfred Lauck : Stability of the Earth's Atmospheric Oxygen, 504
Patchin, George : Retirement from the principalship of the Sir John Cass Technical Institute, 445
Paterson, Dr. C. C. : Appointed a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research, 473
Patil, B. S., and others : Splitting of the Sodium Doublet Lines, 662
Paul, R. H. : Long Transmission-line Problems, 179
Pauli, Prof. Wolfgang : Awarded the Nobel Prize for Physics for 1945, 657 ; work of, 657
Pavlova, V. I. : Research on Conditioned Reflexes, 455
Pearce, Dr. J. A. : Presidential Address to Section III of the Royal Society of Canada, 271
Pearce, J. H. : Potential Theory, *review*, 5
  Functions of a Complex Variable, *review*, 67
Pearce, S. C. : Lognormal Distributions, 747
Peatt, Brigadier E. S. W. : British Army Veterinary Services in the Far East, 60
Peddie, Prof. W. : The Fitzgerald Contraction as the Origin of our Experience of Time and its Lapse Rate, 336
Pedersen, Dr. Kai O. : Ultracentrifugal Studies on Serum and Serum Fractions, 247
Peklo, Dr. J. : Papers on the Genetics of certain Fungi and the Problem of 'Relative Sexuality' among lower Plants, 416
Pelseneer, Dr. P. : *Obituary* by R. Winckworth, 136
Pendlebury, H. M. : *Death* of, 443
Pentzer, W. T., and others : Use of Carbon Dioxide in Fruit Storage and Transport, 178
Percival, Dr. E. G. V. (Dewar, Eric T., and) : A Polysaccharide from *Gigartina stellata*—the Isolation of Crystalline 2 : 6-Dimethyl-*β*-*d*-Galactopyranose from the Methylated Polysaccharide, 633
Perry, Flying-Officer F. C., and others : Mass Departure of Locust Swarms in relation to Temperature, 628
Perry, Stuart H. : Awarded the J. Lawrence Smith Medal for 1945 of the United States National Academy of Sciences, 575
Perutz, Dr M. F. : Elected to an Imperial Chemical Industries Fellowship at Cambridge, 17
Pervukhim, M. : Tribute to Mendeléeff in connexion with the seventy-fifth anniversary of the discovery of the Periodic Law (*VOKS Bulletin* No. 6), 331
Peters, N. : Die Bevölkerung des südatlantischen Ozeans mit Ceratien, 181
Peters, Prof. R. A. : The Vitamin B$_2$ Complex, 86
Peters, Prof. R. A, Stocken, Dr. L. A., and Thompson, Dr. R. H. S. : British Anti-Lewisite (*BAL*), 616
Pettersson, Prof. Hans : Swedish Oceanography during the War, 180
Pharmaceutical Society, College of the : Appointment of Dr. G. A H. Buttle to the University of London chair of pharmacology, 566, 624
Phelps, J. : An Illusion of Size, 269
Phillips, Major C. E. S. : *Obituary* by R. S. Whipple, 228
  Life and work to be commemorated at a meeting at the Royal Institution, 362
Phillips, R. : Appointed to undertake research in animal husbandry and the administration of investigational centres in the Department of Animal Health at the University College of Wales, Aberystwyth, 331
Phillis, Dr. E. : Appointed chief scientific officer, Department of Agriculture, Trinidad, 687
Philpot, A. J. : Automatic Control and Recording in Chemical and other Processes, 723
Philpot, J. St. L. : Serum Proteins in the Ultracentrifuge, 247
Photographic Society, Royal (Scientific and Technical Group) : Series of lectures on How it Works in Photography, 293
Physical Society : Charles Chree Medal and Prize awarded to Dr. John A. Fleming, 658
  Awards, 685
  Exhibition of Scientific Instruments and Apparatus, 714
Physicians of London, Royal College of : Second Interim Report of the Social and Preventive Committee, 148
  Medal Awards, 531
Physics, Institute of (London and Home Counties' Branch) : Discussion on the Corrosion of Metals, 435
Physics, Institute of, the Institution of Chemical Engineers, and the Chemical Engineering Group of the Society of Chemical Industry : Joint conference on Instruments for the Automatic Controlling and Recording of Chemical and other Processes, 45, 723
Piaggio, Prof. H. T. H. : *Obituary* of Dr. A. Lees, 499
  Advanced Mathematics, *review*, 648
Pickard, R Fortescue : Time, Number and the Atom, *review* by F. J. Garrick, 489
Pickford, Dr R. W. : Darkened Violet in Colour Vision, 506
Piersotte, J., and others : Les états de carence en Belgique pendant l'occupation Allemande 1940–1944, *review* by Major J. Marshall, 551
Pike, E. Royston : Faiths of Many Lands, *review* by Enid Blyton, 34
Pitt, Frances : Mass Movement of the Water Shrew, *Neomys fodiens*, 247
Planning and Regional Reconstruction, Association for : Development of its Information Service, 775
Platt, Dr. B. S. : Fermentation and Human Nutrition, 87
Polanyi, Prof. M. : Reform of the Patent Law in Britain, 54
  Friedel-Crafts Catalysts and Polymerization, 638
Polanyi, Prof M. (Evans, Dr. A. G., and) : Low Temperature Polymerization, 638
Pole, Sir Felix : Retirement from the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research, 473
Polish Medical Association : Appeal for books and periodicals, 473
Political and Economic Planning : Broadsheet on Output and the Worker, 91
Pollak, Dr. H., and Wilson, D. G : Absolute and Differential Light Sensitivity of the Dark-adapting Eye, 299
Pollard, E. Parker : Seconded by the Cooper Technical Bureau for research in parasitology in the Department of Animal Health at the University College of Wales, Aberystwyth, 331
Pollard, E. W. : Earthquakes recorded at the Isle of Wight during March, 79 ; during April and May, 201 ; during June, 545 ; on November 27, 712
Pope, Elizabeth C. : Survival of a specimen of *Meuschenia skottowei* after a Major Injury, 714
Pope, Dr. J. A : Appointed lecturer in mechanical engineering in the University of Sheffield, 473
Porter, R. C. : *Death* of, 229 ; *obituary*, 360
Potts, H. E. : *Obituary*, 199
Potts, W. H, and Vanderplank, F. L : Mode of Entry of Contact Insecticides, 112
Powell, Dr C. F. : Cosmic Rays, 544
Powell, E F, and Gough, V. E. : The Mechanism of Rubber Cracking, 11
Powell, H M. (Palin, D E., and) : Hydrogen Bond Linking of Quinol Molecules, 334
Power Conference, World : Meeting of the International Executive Council of the, 660
Prát, Prof. S. : Rostlinopsis, 416
Prescott, Dr. F. : The Vitamin B$_2$ Complex, 87
Prest, Wilfred : Appointed visiting lecturer in the Department of Economics and Commerce of the University of Leeds, 501
Preston, F. W. : Strength of Glass and Duration of Stressing, 55
Price, Stanley A. : Microbiological Assay of Riboflavin, 171
Pringle, R. W., and others : A Photo-Electric Fourier Transformer, 756
Prinz, Dr. G D. : Automatic Control and Recording in Chemical and other Processes, 724
Proebsting, F. L. : Root Distribution of Fruit Trees, 395
Pryor, Dr. M C. : Wood and Glue, 306
Psychological Society, British (Social Psychology Section), and the Royal Anthropological Institute : Discussion on the Scapegoat in Modern Europe, 380
Puffer, Dr Ruth Rice : Familial Susceptibility to Tuberculosis, *review*, 191
Pulfrey, W : Appointed senior geologist, Kenya, 445
Pull, D J. : Automatic Control and Recording in Chemical and other Processes, 724
Pulvertaft, Lieut.-Colonel R. J. V., and Yudkin, Capt. John : Stabilization of Penicillin Solutions by Phosphate, 82
Pye, Ltd. : A New Television System, 565

QUASTEL, Dr. J H : The Vitamin B$_2$ Complex, 86
  Biochemical Aspects of Mental Disorder, 102
  Progress in Biochemistry, *review*, 611
Queen Mary College, London : Retirement of Prof. E. H. Lamb from the chair of civil and mechanical engineering, 137
  Appointment of Dr Edmund Giffen to the chair of civil and mechanical engineering, 137
Queen Victoria Memorial, Salisbury, Southern Rhodesia : Annual Report, 565

RABINOWITCH, Eugene I. : Photosynthesis and related Processes, Vol. I, Chemistry of Photosynthesis, Chemosynthesis and related Processes in Vitro and in Vivo, *review* by Prof F. J. Lewis, 487
Race, Dr R. R. (Coombs, R. R. A., and) : Further Observations on the 'Incomplete' or 'Blocking' *Rh* Antibody, 233
Ráda, Prof. Germán García, and others : Control of Internal Boll Rot of the Cotton Plant, caused by Insect Punctures (*Dysdercus sp.*), through Selection of Resistant Strains, 235
Radcliffe-Brown, Prof. A. R. : Anthropology of Portuguese Timor, *review*, 129
  The Race Problem in South America, *review*, 158

Radio Industry Council Report on Post-War European Broadcasting, 250
Rádl, Prof E. : *Obituary* by Dr G. Druce, 14
Radley, Dr. W. G. : The Corrosion of Metals, 437
Ragg, Ven. Lonsdale : *Death* of, 199 ; *obituary* by Sir Geoffrey Evans, 289
Raisin, Dr. Catherine A. : *Death* of, 106 ; *obituary* by Dr. Doris L. Reynolds, 327
Ramachandran, G. N Crystal Structure of Diamond, 83
Raman, Sir C V. · Allotropic Modifications of Diamond, 22
Ramanathan, R. G. · Infra-Red Spectrum of Diamond, 23
Rammell, J. C. . Appointed conservator of forests, Kenya, 264
Randall, Prof. J. T. : Awarded the Duddell Medal for 1945 of the Physical Society, 685
Randolph, L F., and Cox, L. G Germination of Bearded Iris Seeds, 395
Rao, S. Dattatreya : Utilization of Carotene from Oils, 234
  Influence of Vitamin E on the Utilization of Carotene from Oils, 449
Raven, John C. (arranged by) : Controlled Projection (1944), *review* by Dr. John Cohen, 701
Raw Materials Board, Combined Third Annual Report, 24
Rawitscher, Prof Felix : The Hazel Period in the Post-Glacial Development of Forests, 302
Rawlins, F. Ian G · In Search of Rigour, *review*, 516
Ray, Kamalesh, and Sengupta, Nanda Dulal . Comparative Vacua Produced by Different Oils in a Diffusion Pump, 636
Rayleigh, Lord : John Tyndall, *review*, 189
  Contributions of the Imperial College to the Conquest of Disease, 520
Raymont, T. : Principles of Education, *review*, 676
Rayner, Dr M. C. . Origin of Toxicity to Fungi in Wareham Heath Soil, 174
  Trees and Toadstools, *review*, 732
Read, Prof. John : Explosives in War and Peace, *review*, 5
  Advanced Organic Chemistry, *review*, 96
Read, J. H · Resignation from the lectureship in chemistry in the University of Sheffield, 473
Read, Dr. Margaret : Appointed to the University of London readership in education at the Institute of Education, 533
Reber, Grote : 'Cosmic Static', 396
Reddish, W. (Jackson, Prof. Willis, and) : High Permittivity Crystalline Aggregates, 717
Redeke, Dr. H. C . *Death* of, 15
Reed, R. I., and others . Univalent Electron Transfers in Aromatic Nitration ?, 688
Reekie, Dr. J , and Aird, J. · Flow of Water through Very Narrow Channels and Attempts to Measure Thermomechanical Effects in Water, 367
Rees, Dr W. J. : Retirement as lecturer in refractories in the University of Sheffield, 79
Relf, E. F Appointed principal of the College of Aeronautics, 623 ; work of, 624
Research Corporation of New York : Grants for research, 744
Research Defence Society · Stephen Paget Memorial Lecture (Sir William Savage), 417
Reynolds, Dr. Doris L · *Obituary* of Dr. Catherine Alice Raisin, 327
Reynolds, L. G. S. : *Death* of, 229
Reynolds-Davies, R. W. Appointed deputy secretary of the Institute of Fuel, 329 ; work of, 329
Rheologists' Club, British : Conference on Strength of Materials, 306
  Fifth Annual General Meeting, 745
  Re-election of Prof. E. N. da C. Andrade as president, 745
  and the Manchester Section of the Oil and Colour Chemists' Association : Discussion on the General Rheological Properties of Suspensions, 745
Rice, William B. : Quality Control in Business Production and Administration, 330
Richard, J. J. : Kilimanjaro—Crater Fumaroles of Kibo and Seismic Activity during 1942–45, 352
Richards, Dr. A. I. : Appointed to the University of London readership in anthropology at the London School of Economics, 533
Richmond, H. : The Film Strip in Technical Training, 426
Richter, C. F. (Gutenberg, B., and) Frequency of Earthquakes in California, 371
Richter, Dr. D. Biochemical Aspects of Mental Disorder, 102
Rideal, Prof. E. K. : Reactions in Monolayers, 468
  Appointed Fullerian professor of chemistry in the Royal Institution and director of the Davy Faraday Research Laboratory, 714, 774 ; work of, 774
  Retirement as professor of colloid science in the University of Cambridge, 774
Rideal, Prof. E. K., and Evans, Dr. U. R. : *Obituary* of Prof. Leif Tronstad, 74
Riet Lowe, Prof. C. van · Pitfalls in Prehistory, 777
Riley, Norman . Some British Moths, *review*, 34
Rishbeth, Mrs. K. : Arts and Crafts of the Cook Islands, 61
Ritchie, Prof. A. D. : Cause and Sensation in Philosophy, *review*, 33
  Politics and Morals (Benedetto Croce), translated from the Italian by Salvatore J. Castiglione, *review*, 281
  Classification of Recent Philosophy, *review*, 376
Ritchie, Dr. P. D. . Part-time Technical Education, 57
Rivett, Sir David : The Application of Science to Industry in Australia, 472
Roberts, Dr. Walter O. : Spicules on the Sun, 362
Robertson, Prof. Andrew : Training of Engineers, 775
Robertson, Sir Charles Grant : The Idea of a University, 263
Robertson, Prof. J. K. : Continuity and Discontinuity, 271
Robertson, Sir Robert : Retirement from the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research, 473
Robinson, Dr. D. H. (edited by) : Vegetable and Fruit Growers' Conferences, *review*, 489
Robinson, F. A. · The Vitamin B_1 Complex, 86
Robinson, G. (Hill, Major K. R., and) : A Fatal Case of D.D.T. Poisoning in a Child, 780
Robinson, Mrs. J. : The Inter-relations between the Natural and Social Sciences, 653
Robinson, Keith (Brindley, Dr. G. W., and) : Structure of Kaolinite, 661
Robinson, Sir Robert : Elected president of the Royal Society, 684 ; work of, 684
Robson, Dr G. C. : *Obituary* by Dr. E. Hindle, 75
Rochester, Dr. G. D., and McCusker, C. B. A. : Effect of the Pressure of Alcohol Vapour on the Operation of the Fast Geiger-Muller Counter, 366
Rockefeller Foundation · Grant of 6,500 dollars to the University of Leeds for the purchase of equipment in connexion with Prof. W. T Astbury's researches, 502
Rodda, Harold J. (Macbeth, Prof. A. Killen, and) : Amino-quinazolines, 207
Rogerson, Sidney · Hexachlorocyclohexane as an Insecticide, 424
Rogozinsky, A. . Cosmic Rays, 543
Rolleston, Dr J. D · Folk-Lore of Toothache, 387
Rontgen, Wilhelm Konrad : Fiftieth anniversary of the discovery of X-Rays by, 531
Roonwal, Dr M. L. Presence of Reddish Pigment in Eggs and Ovarioles of the Desert Locust, and its Probable Phase Significance, 19
de Rosayro, C., and others : Need for Development of Tropical Ecological Studies, 627
Rose, E. J. : The Teaching of Science in Secondary Schools, 56
Rose, F. Campbell Logarithmic Scales, 268
Rosen, B. . Spectra of Diatomic Oxides by the Method of Exploded Wire, 570
Rosenfeld, Prof. L. : Penetration of Fast Nucleons into Heavy Atomic Nuclei, 141
Rosental, I S (Vassilieva, L. V., and) : Research on Conditioned Reflexes, 455
Rotblat, Dr J. · *Obituary* of Prof. Ludwik Wertenstein, 384
Rowan, Prof. Wm. : Inheritance and Acquired Characteristics, 236
Rowe, A. P. · Appointed deputy controller for research and development in the Admiralty, 472
Rowett Research Institute : Appointment of Dr. D. P. Cuthbertson as head, 685
Roy, Rai Bahadur Sarat Chandra : Essays in Anthropology Presented to (edited by J P. Mills, B. S. Guha, K. P. Chattopadhayay, D. N. Majumdar and A. Aiyappan), *review* by Prof J. H Hutton, 66
Royal Aircraft Establishment Pamphlet on Aeronautical Training, 78
Royal Anthropological Institute and the Social Psychology Section of the British Psychological Society Discussion on the Scapegoat in Modern Europe, 380
Royal Asiatic Society of Bengal · Conference on Indology and Oriental Culture, 687
Royal Botanic Gardens, Kew · Appointment of Dr. Debabrata Chatterji as assistant for India, 444
Royal College of Chemistry (Dr E. Frankland Armstrong), 524
Royal College of Physicians of London Second Interim Report of the Social and Preventive Committee, 148
  Medal Awards, 531
Royal Geographical Society · Exhibition of German Military Maps, 445
  Appointment of Lieut.-Colonel L. P. Kirwan as secretary, 445
  Christmas Lectures, 714
Royal Horticultural Society · Offer of the Jones-Bateman Cup for original research in fruit culture, 17
Royal Institution · Graduate Memberships, 202
  Meeting to commemorate the life and work of the late Major Charles E. S. Phillips, 362
  Appointment of Prof Eric K. Rideal as Fullerian professor of chemistry and director of the Davy Faraday Research Laboratory, 714, 774
Royal Photographic Society (Scientific and Technical Group) : Series of lectures on How it Works in Photography, 293
Royal School of Mines—Geology, Mining and Metallurgy at the Imperial College (Prof W. R. Jones), 706
Royal Society : Croonian Lecture (Dr. W. T. Astbury), 89
  Croonian Lecture (Prof. August Krogh), 542
  Medal Awards, 596, 694
  Anniversary Meeting, 684
  Election of Sir Robert Robinson as president, 684
Royal Society of Arts : Prize and Award under the Thomas Gray Memorial Trust, 17
Royal Society of Canada : Annual Meeting of the, 271
  Presentation of Medals, 271
  Election of officers for 1945–46, 272
  Election of new fellows, 272
Royal Society of Edinburgh : Presentations, 44
  Election of officers, 533
Royal Society of Medicine (Psychiatry Section) : Meeting on the Biochemistry of Mental Disorder, 101
Royal Society of Medicine, in co-operation with the Scientific Film Association : To prepare a catalogue of Medical Films in Great Britain, 387
Royal Society of South Africa : Election of fellows, 687
Royal Statistical Society : Industrial and Agricultural Research Section to be reconstituted, 667
Royal Technical College, Glasgow : Appointment of Dr. F. S. Spring to the chair of organic chemistry, 685
  Retirement of Dr. G. S. Cruickshanks as lecturer of fuels, 687
  Appointment of Dr. John R. Campbell as lecturer in fuels, 687
Rubber Industry, Institution of the (Midland Section of the) . Symposium on the Physical and Chemical Breakdown of Rubber, 9
Ruhemann, Dr. M. : Some Comparisons between Universities, 184
Rush, Benjamin (1745–1813), 743
Rushton, Dr. W. A. H. : Motor Response from Giant Fibres in the Earthworm, 109
Russ, Prof. Sidney : Custody of Uranium, 303
Russell, Dr. E. S. : Retirement from the post of director of fishery investigations in the Ministry of Agriculture and Fisheries, 687
  The Directiveness of Organic Activities, *review* by Dr. C. H. Waddington, 731
Russell, F. S. : Appointed director of the Marine Biological Association Laboratory, Plymouth, 76
Russell, Sir John : Experiences of a Woman Farmer, *review*, 280
  Ecology in the Service of Man, *review*, 675
Russell, Prof. L. J. : Method in Metaphysics, *review*, 217
Rust, Frederick F., and others : Halogenation in the Allyl Position, 53
Ryan, Miss Phyllis . *See under* Mrs. Seán T. O'Kelly
Ryder, Colonel C. H. D. : *Death* of, 106 ; *obituary* by Brigadier Sir Clinton Lewis, 326
Rye, R. A. : *Death* of, 360
Ryle, Prof. J. A. : Appointed a member of the Industrial Health Research Board of the Medical Research Council, 566
  Science and Ethics, 619
Ryle, M. : Elected to an Imperial Chemical Industries Fellowship at Cambridge, 17

SACHS, Prof. Hans : Library of, acquired by the Museum Book Store, Ltd , 264
Saha, J. C., and Bhattacharjee, S K. . Artificial Production of Ergot in the Tropical Plains of Bengal, 363
Saha, Prof. M N   A Physical Theory of the Solar Corona, 649
Salisbury, Dr. E J. . The Rural Pursuits of President Jefferson, *review*, 128
  Awarded a Royal Medal of the Royal Society, 596, 695
Sand, Dr. Alexander   *Death* of, 106 ; *obituary* by Prof. T. A. Stephenson, 383
Sanders, F. R. · Appointed senior agricultural officer, Tanganyika, 445
Sansome, Eva : Heterokaryosis and the Mating-Type Factors in *Neurospora*, 47
Sansome, Dr. F W.   *Obituary* of Prof F. von Wettstein, 328
Sastry, S. L. (Ghosh, Sir J. C., and)   Chromium Oxide as a Promoter in Catalysts for the Fischer-Tropsch Synthesis, 506
Satti, Mohamed Hamed (Horgan, Dr E S , and)   Penicillin in Kala Azar, 297
Saunders, Miss E R · *Obituaries* by Miss G. L Elles and Dame Ethel Shakespear, 198 , Prof. J. McL. Thompson, 198 ; Prof. J B S. Haldane, 385
Savage, J H. . Localization of Faults in Low-Voltage Cables, 201
Savage, Sir William . Public Health and its Debt to Experimental Medical Research, 417
Savard, l'Abbé Felix Antoine · Awarded the Lorne Pierce Medal of the Royal Society of Canada, 271
Savory, T. H. . The Black Widow Spider, *review*, 253
Schering Research Institute, British . Appointment of Dr. J S H. Davies as director of research, 626
Scheuer, E. : *Obituary* of Prof. W. H. Fraenkel, 773
Schmalhausen, O I. (Zernov, S. A., and) : Low-Temperature Limits of Life, 304
Schmidt, Dr. O J · A Meteoric Theory of the Origin of the Earth and Planets, 185
Schneider, Dr. Otto ° *Obituary* of Dr. W. Knoche, 328
Schonland, Prof. B. F. J : Awarded the Hughes Medal of the Royal Society, 596, 696
Schrieke, Dr. B. O J. : *Death* of, 360
Schultz, L. P. : American Clingfishes, 304
Schuman's : Catalogue 10, 293
Science Museum . Retirement of Colonel E. E. B. Mackintosh as director and secretary, 626, 658
  Appointment of Dr. Herman Shaw as director and secretary, 626, 658
Scientific Film Association . Conference on the Film in Science, 79, 426
Scientific Film Association in co-operation with the Royal Society of Medicine : To prepare a catalogue of Medical Films in Great Britain, 387
Scientific Instrument Manufacturers' Association of Great Britain   Election of officers, 202
Scientific Societies, South-Eastern Union of : Fiftieth Annual Congress, 211
Scientific Workers, Association of : Appointment of Roy Innes as general secretary, 331
  Discussion on the Inter-relations between the Natural and Social Sciences, 652
  (Leeds Branch) · Conference on Science and Education, 56
Scientific and Industrial Research, Advisory Council to the Committee of the Privy Council for · Appointment of Prof H Munro Fox, Prof. I. M. Heilbron and Dr C. C Paterson as members, 473
Scotland (West of) Field Studies Council · Inauguration of the, 331
Scott, Dr. J. R.   The Heat Ageing of GR-S Vulcanisates, 10
Scottish Marine Biological Association : Annual Reports for 1938–39 to 1943–44, 668
Sea, International Council for the Exploration of the : Reconstitution of the, 597
Seaber, W. M (Mann, T. Barton, and) . Determination of β-Carotene in Dried Grass, 571
Sen, Prof. H. K. : *Death* of, 596
Sen, N. R , and Burman, U. R. . Nuclear Energy Generation in the Sun, 305
Sengupta, Nanda Dulal (Ray, Kamalesh, and) . Comparative Vacua Produced by Different Oils in a Diffusion Pump, 636
Senn, Prof. Gustav : *Death* of, 229 ; *obituary* by Sir D'Arcy Thompson, 289
Sensory Devices for the Blind Committee · Set up by the Council of St. Dunstan's, 200
Seton, Lady : Mass Movement of the Water Shrew, *Neomys fodiens*, 247
Sevag, Prof. M. G. : Immuno-Catalysis, *review* by Dr P. Johnson, 517
Sexton, Dr. W. A. (Templeman, Dr. W. G., and) : Effect of some Arylcarbamic Esters and related Compounds upon Cereals and other Plant Species, 630
Seymour, Flight-Lieut. W. G , and others : Mass Departure of Locust Swarms in relation to Temperature, 628
Shah, Prof. M. A. : The Popliteal Facet in Men who Habitually Squat, 237
Shakespear, Dame Ethel (Elles, Miss G. L., and) : *Obituary* of Miss E. R. Saunders, 198
Shapiro, B., and Wertheimer, E. : Acetylphosphatase in Animal Tissues, 690
Sharman, Dr. B. C : Thatch Grass, 342
Shattock, G. · Awarded a Boots Undergraduate Scholarship by the Veterinary Educational Trust, 473
Shaw, Dr. H. : *Obituary* of E. Lancaster-Jones, 442
  Appointed director and secretary of the Science Museum, 626, 658 ; work of, 658
Shearer, Prof. Ernest : *Death* of, 415 ; *obituary* by Prof. J. A. More, 470
Sheffield City Libraries : Select Bibliography on British Industry and Commerce, 44
Sheldon, Prof. Wilmon Henry : Process and Polarity, *review* by Prof. A. D. Ritchie, 376
Sherman, Prof. Henry C. : The Science of Nutrition, *review*, 318
Shimkin, Dr. M. B. : Mammary Tumours in Mice, 787
Shipton, P. J. (Shreeve, A. G., and) . Over-Current Relays on Medium-Voltage Circuits, 305
Shirley, Dr. J. : Resignation from the lectureship in geology in the University of Sheffield, 473
Shoenberg, D. (Bauchwitz, F. K., and) : A New Interference Effect, 142
Shorland, Dr. F. B. : Occurrence of Hexadecatrienoic Acid in the Glycerides of Rape (*Brassica napus* L.) Leaf, 269
Shorten, Monica . Inheritance of Melanism in Grey Squirrels, 46
Shotter, G. F. : Meter and Instrument Jewels and Pivots, 89
Shreeve, A. G., and Shipton, P. J. : Over-Current Relays on Medium-Voltage Circuits, 305
Shukri, Dr. N. M. . Geology of the Nubian Sandstone, 116
Sibson, A. R. . Future of Electricity Supply in Matabeleland, 168
Siddiqui, Dr. S. . Organisation of Scientific Research in the British Commonwealth, 758
Sidgwick, Prof N V , and Springall, H. D. : Energy of the Hg—C Bond and the Heat of Atomization of Carbon, 599
Siegbahn, Dr Kai, and Slatis, Dr. Hilding · Radioactivity of Active Nitrogen, 568
Simon, E. N   Some Problems of the Special Librarian in Industry, 605, 606
Simonsen, Prof. J L : *Obituary* of Sir Martin Forster, 13
  Organisation of Scientific Research in the British Commonwealth, 758
Simpson, Sir George . The Pleistocene Period, *review*, 730
Simpson, George Gaylord   Tempo and Mode in Evolution, *review* by Dr Julian S. Huxley, 3
Simpson, Miss M. C. · Resignation as assistant bacteriologist in the University of Sheffield, 473
Sims, Mrs. A. M : Offer to the University of Cambridge to establish a Trust Fund, 140
Singh, Bawa Kanwal : Temperature Effect on Ultra-sonic Velocity in Water, 569
Singh, Kartar (Narayanamurti, D., and) : Preliminary Studies on Improved Wood, Part 3, Compregnated Wood, 787
Sinitsin, Prof Nikolai . Transplantation of the Heart, 536
Sirkar, Dr. S. C , and Bishui, B. M. : Fluorescence of Dipropyl Ketone at Low Temperatures, 333
Sjogren, Bertil (Ekstrand, Torsten, and) : Production of *p*-Aminobenzoic Acid by the Tubercle *Bacillus*, 476
Skinner, Dr. H. A. : The Molecular Structure of the Catalytic Halides, 638
Skinner, Dr. H. A , and Sutton, Dr. L. E. · Aluminium Trimethyl, 601
Slätis, Dr. Hilding (Siegbahn, Dr. Kai, and) : Radioactivity of Active Nitrogen, 568
Smith, A. E. Wilder, and Williams, P. C. : Instability of Dienœstrol and Stilbœstrol Solutions, 718
Smith, E , and others · Use of Carbon Dioxide in Fruit Storage and Transport, 178
Smith, Dr E. W. . Elected president of the Institute of Fuel, 45
Smith, Sir Frank . Automatic Control and Recording in Chemical and other Processes, 723
Smith, Dr F., and others : A Constitutional Synthesis of Chondrosamine, 308
Smith, G. Sumner . Awarded a Boots Undergraduate Scholarship by the Veterinary Educational Trust, 473
Smith, Herbert Williams : Awarded a Wellcome Fellowship for Veterinary Research, 45
Smith, Prof Turner L. (Sternberg, Wolfgang J., and) . The Theory of Potential and Spherical Harmonics, *review* by J. H. Pearce, 5
Smith, W Sydney · *Obituary*, 414
Smith, Sir W. Wright . Elected president of the Royal Society of Edinburgh, 533
Smithsonian Institution : Classified List of Publications Available for Distribution (Helen Munroe), 362
Smock, R M., and others : Use of Carbon Dioxide in Fruit Storage and Transport, 178
Smyth, Prof. H. D. : A General Account of the Development of Methods of Using Atomic Energy for Military Purposes under the Auspices of the United States Government, 1940–1945, 768
Smyth, J. L. : Appointed a member of the Industrial Health Research Board of the Medical Research Council, 566
Snell, Dr. Cornelia R. : Appointed chairman of the New York Section of the American Chemical Society, 230 ; work of, 230
Social Hygiene Council, British, and the Town and Country Planning Association . Conference on the Needs and Problems of the Family, 777
Society of Agricultural Bacteriologists : Name changed to the Society for Applied Bacteriology, 481
  Papers at the Summer Conference, 481
Society for Applied Bacteriology : Papers at the Summer Conference, 481
Society of Chemical Industry : Annual Reports on the Progress of Applied Chemistry, Vol. 28, 1943, *review*, 281
Society of Chemical Industry (Chemical Engineering Group), the Institution of Chemical Engineers, and the Institute of Physics : Joint conference on Instruments for the Automatic Controlling and Recording of Chemical and other Processes, 45, 723
Society of Czechoslovakian Mathematicians and Physicists : Conference on the Use of X-Ray Methods in the Metal Industry, 473, 502
Society for Freedom in Science . Occasional Pamphlet No. 1, Is the Progress of Science Controlled by the Material Wants of Man ? (Dr. F. Sherwood Taylor), 166
Society for the Promotion of Nature Reserves : Report by the Geological Sub-Committee of the Nature Reserves Investigation Committee on National Geological Reserves in England and Wales, 485
Society for Visiting Scientists : Meetings to discuss the organisation of research within the British Commonwealth, 660, 758
Soltys, Dr. M A. : Chemotherapy of Tuberculosis, 210
Sommer, Dr. A. : Visible Glow Discharge at Very Low Potentials, 242
Sorsby, Prof. Arnold : Medicine and Mankind, *review*, 129
  Medicine in the U.S.S.R., 226
Sorsby, Prof. Arnold, and O'Connor, A D. . Measurement of the Diameters of the Living Eye by means of X-Rays, 779
Soule, F. M., and others : Observations and Results in Physical Oceanography, 341
South-Eastern Union of Scientific Societies : Fiftieth Annual Congress, 211
Southwell, Dr. R V. : Reply to H.M. the King's Address to the Imperial College of Science and Technology, 518
Southworth, G. C : Microwave Radiation from the Sun, 274
Speakman, Prof. J. B. . The Education of the Technologist, 57
Speakman, Prof. J B. (Menkart, J., and) : Scaliness of Wool Fibres, 143
Speakman, Prof. J. B. (Neish, W. J. P., and) : Unshrinkable Wool, 176
Speakman, Dr. J. C. : Resignation as lecturer in chemistry in the University of Sheffield, 745
Spearman, Prof. C. E. : *Death* of, 360 ; *obituary* by Prof. Cyril Burt, 740

Special Libraries and Information Bureaux, Association of · Conference on Microfilm and other Means of Documentary Reproduction, 24
  Report of the Proceedings of the Nineteenth Conference, 108
  Twentieth Annual Conference, 232, 605
Spring, Dr. F. S. : Appointed to the chair of organic chemistry at the Royal Technical College, Glasgow, 685 ; work of, 685
Springall, H. D. (Sidgwick, Prof. N. V , and) : Energy of the Hg—C Bond and the Heat of Atomization of Carbon, 599
St. Dunstan's, Council of : Committee to be known as the Sensory Devices for the Blind Committee, 200
Stacey, Dr. Maurice : Title of reader in biological chemistry in the University of Birmingham conferred on, 140
Stacey, Dr. Maurice, and others A Constitutional Synthesis of Chondrosamine, 308
  Nature of the Gram-positive Complex in Micro-organisms, 720
Ställberg-Stenhagen, Stina, and Stenhagen, Einar : Phase Transitions in Condensed Monolayers of Normal Chain Carboxylic Acids, 239
Stamp, Dr. L. Dudley · Appointed to the University of London chair of geography at the London School of Economics and Political Science, 202, 291 ; work of, 291
  Nationalization of Mineral Rights, 667
Standard Telephones and Cables, Ltd. : Central laboratory organisation to undertake long-term research and development in the telecommunication, electronics and allied fields, 777
Stapledon, Sir George : Elected president of the British Grassland Society for 1945, 78
  To retire from the directorship of the Grassland Improvement Station, 598
Statistical Society, Royal · Industrial and Agricultural Research Section to be reconstituted, 667
Steavenson, Dr W. H · Co-ordinates of Nova Tamm, 473
Stebbing, Prof. E. P. · Indigenous Forests of New Zealand, 60
  Post-War Forest Policy in India, 286
Steedman, Dr. H F. · Ester Wax, a New Embedding Medium, 121
Stenhagen, Einar (Ställberg-Stenhagen, Stina, and) : Phase Transitions in Condensed Monolayers of Normal Chain Carboxylic Acids, 239
Stephen, Joan M. L , and others : Antimalarial Activity in Tetrahydroacridones and related Substances, 629
Stephenson, Prof. T. A. : The Constitution of the Intertidal Fauna and Flora of South Africa, Part 2, 27
  Obituary of Dr. Alexander Sand, 383
Stern, Prof Lena : Direct Chemical Action upon Nerve Centres in Biology and Medicine, 7
Sternberg, Wolfgang J., and Smith, Prof. Turner L. · The Theory of Potential and Spherical Harmonics, *review* by J. H. Pearce, 5
Stettinius, E. R. · Lend-Lease, Weapon for Victory, 78
Stewart, Dr. A. B. · Granted leave of absence to advise the Government of India on soil fertility and crop production, 566
Stewart, Derek : Film as an Instrument of Scientific Research, 426
Stocken, Dr L A., and others · British Anti-Lewisite (*BAL*), 616
Stokes, A R. (Bragg, Sir Lawrence, and) · X-Ray Analysis with the Aid of the 'Fly's Eye', 332
Štorkán, Prof. J. · *Obituary* by Dr. G. Druce, 75
Stoy, R. H., and Menzies, A. · Re-Observation of the Magnitudes of the Southern Comparison Stars for Eros, 179
Stratton, Prof. F. J. M. : Some Cambridge Men, *review*, 348
Stresemann, Dr. Erwin : Letter on German Ornithology, 578
Strong, Prof. J. . *Death* of, 443
Sunvic Controls, Ltd : Energy Regulators, 167
Supply, Ministry of : Release of Dr H. J. Gough, 168
  Appointment of Prof. J E Lennard-Jones as chief scientific officer, 168
Surugue, J. : Cosmic Rays, 544
Surveyor, Arthur : Reappointed a member of the National Research Council of Canada, 416
Sussman, Sheila, and others : B Vitamins in African Fermented Foods, 364
Sutherland, Dr. G B. B M (Cannon, C. G., and) · Infra-Red Spectra of Coals, 240
Sutton, Dr. L E. (Skinner, Dr. H. A., and) Aluminium Trimethyl, 601
Sverdrup, H. U., and others . Observations and Results in Physical Oceanography, 413
Swabey, C. : Appointed conservator of forests, British Guiana, 445
Swainson, O. S. Appointed senior agricultural officer, Zanzibar, 264
Swarbrick, Thomas · Parthenocarpic Production of Tomato Fruits, 300
  Use of Growth-Promoting Substances in the Prevention of Apple Drop following Frost, 691
Sykes, Brigadier-General Sir Percy *Obituaries* by Dr. J. V. Harrison and Prof. V. Minorsky, 104
Sykes, Dr. P. H. : Friedel-Crafts Catalysts in Carbon-Monoxide Reactions, 638
Sykes, R. F. (Murgatroyd, J. B., and) : Mechanism of Brittle Rupture, 716
Sylvester-Bradley, P. C. · Appointed assistant lecturer in geology in the University of Sheffield, 745

TABOR, Dr. D., and others : Lubrication of Metal Surfaces by Fatty Acids, 97
Tagg, G. F. : Moving-Coil Instruments, 396
Talalay, Anselm, and Magat, Michael · Synthetic Rubber from Alcohol, *review* by Dr. W. J. S. Naunton, 251
Talbot, P. H. B : A Modification of Slide-Culture Technique, 391
Tamm, Dr. : Discovery of a nova in the constellation of Aquila, 473
Tang, P. S , and others : An Antibiotic Substance in the Chinese Water-chestnut, *Eleocharis tuberosa*, 234
Tasker, H. S., and Towers, S. W. : 'Electron Radiography' using Secondary β-Radiation from Lead Intensifying Screens, 50
Tata Memorial Hospital : First Triennial Report, 776
Tavener, F. E. . Appointed director of surveys, Uganda, 445
Tawde, Prof. N R , and others : Splitting of the Sodium Doublet Lines, 662
Taylor, Prof. A. E. · Aristotle's Criticism of Platonism, *review*, 647
Taylor, Dr. F. Sherwood . Is the Progress of Science Controlled by the Material Wants of Man ?, 166
Taylor, H. S. · Awarded a Boots Undergraduate Scholarship by the Veterinary Educational Trust, 473
Taylor, Major-General Sir John Organisation of Scientific Research in the British Commonwealth, 758
Taylor, Taylor and Hobson, Ltd., E. R. Watts and Son, Ltd., and the Coventry Gauge and Tool Co., Ltd. : To co-operate in the development and distribution of precision engineering and optical equipment, 387
Tchernomoretz, I. : Multiplication *in vitro* of Koch Bodies of *Theileria annulata*, 391
Teale, Sir Edmund : The Contribution of Colonial Geological Survey to the Development of the Mineral and other Resources of East and West Africa, 167
Teece, Dr. Ethel G , and others : Nature of the Gram-positive Complex in Micro-organisms, 720
Telford, Flight-Lieut. T. M., and others . Mass Departure of Locust Swarms in relation to Temperature, 628
Templeman, Dr. W. G., and Sexton, Dr. W. A. : Effect of some Arylcarbamic Esters and related Compounds upon Cereals and other Plant Species, 630
Thaysen, Dr. A C., and Butlin, K. R. : Inhibition of the Development of *Fusarium oxysporum cubense* by a Growth Substance produced by Meredith's Actinomycetes, 781
Theobald, L S · Title of University of London reader in analytical chemistry conferred on, 566
Theorell, Prof. Hugo : Can the Iron in Peroxidase be Replaced by Manganese ?, 474
Thirumalachar, Prof. M. J : Ergot on *Pennisetum Hohenackeri* Hochst., 754
Thomas, A , and others : Les états de carence en Belgique pendant l'occupation Allemande 1940–1944, *review* by Major J. Marshall, 551
Thomas, A. Morris Electric Discharge on a Dielectric Surface (Lichtenberg Figures), 451
Thomas, Harold · People Who Live in Glass Houses, 501
Thomas, Wing-Comdr H. Hamshaw : Recent Developments in Air Photography, 409
Thomas, J. F. H. · Sheep, *review* by Dr. J. E. Nichols, 251
Thomas, Dr. P. T. : Experimental Imitation of Tumour Conditions, 738
Thomas, T. R · Appointed consulting veterinary surgeon to the Department of Animal Health in the University College of Wales, Aberystwyth, 331
Thompson, Sir D'Arcy : Awarded the honorary degree of D.C.L. of the University of Oxford, 17, 43
  Obituary of Prof Gustav Senn, 289
  The Blackbird (A. F. C. Hillstead), *review*, 318
  Awarded the Daniel Giraud Elliot Medal for 1942 of the United States National Academy of Sciences, 575
  A Simplified Chemical Notation, 715
Thompson, Dr. Eleanor C. (Beakbane, Dr. A. Beryl, and) : Abnormal Lignification in the Wood of some Apple Trees, 145 ; *erratum*, 202
Thompson, Dr Harold : A Biological and Economic Study of the Cod (*Gadus callarias* L.) in the Newfoundland Area including Labrador, 213
Thompson, Dr. H. W. : Chemical Analysis and Structural Diagnosis by Infra-red Absorption, *review*, 65
Thompson, Prof. J. McL. : *Obituary* of Miss E. R. Saunders, 198
Thompson, Dr. R. H S , and others : British Anti-Lewisite (*BAL*), 616
Thompson, Dr. W. R. · Biological Control of Insect and Plant Pests, 271
Thomson, Prof. R. B : Awarded the Flavelle Medal of the Royal Society of Canada, 271
Thornton, D. · Appointed senior agricultural officer (soil erosion), Tanganyika, 687
Thornton, Dr. H G. : Effective and Ineffective Strains of Legume Nodule Bacteria, 654
Thorp, J M., and others · B Vitamins in African Fermented Foods, 364
Thorp, Raymond W., and Woodson, Weldon D. : Black Widow, America's Most Poisonous Spider, *review* by T. H Savory, 253
Thorpe, Dr W H. . Animal Learning and Evolution, 46
Tiffeneau, Prof Marc · *Obituary* by Prof. Alex. McKenzie, 656
Tilley, Prof. C. E. : *Obituary* of Prof. Alexander Fersman, 12
Tillotson, E. : Study of Earthquakes, *review*, 95
Timmermans, Prof. Jean · Some Comparisons between Universities, 183
Tinbergen, Dr. N. : Scientific Affairs in Holland, 576
Tocher, Dr. J. F. : *Death* of, 623
Todd, F. H *Death* of, 106
Todd, J. McA. · Appointed plant pathologist, Gold Coast, 264
Tomkeieff, S I . The Giant's Causeway, 425
  Chemical Composition of Marine Organisms, 607
  Volcanological Station of Kamchatka, 640
  Non-Metallic Deposits of the U S S.R , 759
Tomlinson, T. G. : Control by D D T. of Flies Breeding in Percolating Sewage Filters, 478
Tonkin, Isabel M., and others : Antimalarial Activity of Tetrahydroacridones and related Substances, 629
Tonkin, Isabel M., and Work, T. S. : A New Antimalarial Drug, 630
Toombs, H. A. : Appointed honorary general secretary of the London Natural History Society, 108
Toovey, F. W. : Appointed senior botanist, Nigeria, 687
Tošić, J., and Walton, Dr. Arthur : Respiration of Spermatozoa in Egg-Yolk Medium, 507
Towers, S W. (Tasker, H. S , and) 'Electron Radiography' using Secondary β-Radiation from Lead Intensifying Screens, 50
Town and Country Planning, Minister of : Appointment of a National Parks Committee, 108
Town and Country Planning, Ministry of · National Maps of Britain, 776
Town and Country Planning Association (British Social Hygiene Council and the) : Conference on the Needs and Problems of the Family, 777
Tranter, Prof. C. J *Obituary* of Prof. C E. Wright, 742
Trease, George Edward : A Text-Book of Pharmacognosy, fourth edition revised, *review* by Dr. W. O. Howarth, 96
Tritton, F. J. : Microfilm and other Means of Documentary Reproduction, 24
Tronstad, Prof. Leif . *Obituary* by Prof. E. K. Rideal and Dr. U. R. Evans, 74
Truscot, Bruce : Some Comparisons between Universities, 183
  Redbrick and These Vital Days, *review* by R. Brightman, 432
Tsanoff, Prof. R. A. . The Problems of Education in International Morality, 444
Tsien, L. C , and Chu, H. C. : Harmonics in the Piezo-Electric Oscillation of a Quartz Crystal, 424

Tsien, M. : Cosmic Rays, 543, 544
Turnbull, Prof. H. M. : Honorary degree of D.Sc. of the University o Oxford conferred on, 108
Turner and Newall, Ltd. : Annual Grant of £600 to the University of Leeds for a research fellowship in engineering, chemistry, physics, textile industries or any allied science, 502, 659
Turney, Dr. T. H. : Heaviside's Operational Calculus Made Easy, *review* by Dr. L. E. C. Hughes, 6
Turrill, W B. : *Obituary* of Prof John Borg, 14
Twiss, Dr. D. F. : Physical and Chemical Degradation of Rubber, 9
Twyman, F. : Apprenticeship for a Skilled Trade, 155
Tyndall, John : Life and Work of (A. S Eve and C. H Creasey), *review* by Lord Rayleigh, 189

UBBELOHDE, Dr. A. R., and Woodward, Miss I. : Laue Photographs of Sub-crystalline Regions in 'Hybrid' Crystals of Potassium Dihydrogen Phosphate, 20
Ulrich, Prof. F. : *Obituary* by Dr. G. Druce, 75
Underwood, Dr. E. Ashworth : Appointed director of the Wellcome Historical Medical Museum and the Wellcome Historical Medical Library, 416
United Nations Economic and Social Council : Science in the, 625
United Nations Educational and Cultural Organisation . Conference to consider the establishment of a, 79
  Draft proposals for a, 263
United Nations Fellowship : Discussion on the Problems of Education in International Morality, 444
United Nations Food and Agriculture Organisation . Appointment of Sir John Boyd Orr as the first director-general, 533
  Work of the Interim Committee, 727
United Nations Information Organisation . Towards a World of Plenty, 727
United Nations Relief and Rehabilitation Administration : European Agriculture, 15
United States National Academy of Sciences : Elections and Medal Awards, 575
  American Pharmaceutical Manufacturers' Association Award of Distinction presented to the National Research Council, 575
  Lord and Taylor Annual American Design Award for 1945 awarded to the, 575
United States National Academy of Sciences and the American Philosophical Society : Joint meeting on Atomic Energy and its Implications, 687
United States War Department : Outstanding German men of science to be taken to the United States, 445
University of Birmingham : Title of reader in biological chemistry conferred on Dr. Maurice Stacey, 140
University of Bristol : Appointment of A. R Collar to the chair of aeronautical engineering, 43
  Anglo-French conference on Cosmic Rays, 543
  Appointment of Phillip Morris as vice-chancellor, 659
University of Cambridge · Offer from Mrs A. M Sims to establish a Trust Fund, 140
  Retirement of Dr. A D Imms from the readership in entomology, 712
  Appointment of Dr. V. B. Wigglesworth to the readership in entomology, 712
  Retirement of Prof. E. K Rideal as professor of colloid science, 714, 774
University of Durham : Appointment of G. H. Forsyth to the chair of mechanical and marine engineering at King's College, Newcastle-upon-Tyne, 140
  Appointment of Dr David H. Valentine to the readership in botany in the Durham Colleges, 140
  Appointment of Dr. A. C. Offord to the chair of mathematics in the Newcastle Division, 202
  Appointment of W. H. F. Barnes to the chair of philosophy in the Durham Division, 202
University of Edinburgh · The senior Hume Brown Prize in Scottish History awarded jointly to Dr. Alexander Clow and Mrs. Nan L. Clow, 45
  Appointment of Prof. Norman Feather as professor of natural philosophy, 415
University of Glasgow : Election of Sir John Boyd Orr as rector, 502
University of Leeds · Appointment of Dr. Irene Manton to the chair of botany, 108, 230
  Retirement of Prof. Robert W. Whytlaw-Gray from the chair of chemistry, 386
  Appointment of Prof. M. G Evans and Dr. E. G. Cox to the chairs of chemistry, 386
  Appointment of Dr. W. T Astbury to the chair of biomolecular structure, 501
  Title of emeritus professor conferred on Prof. R W. Whytlaw-Gray, 501
  Appointment of Wilfred Prest as visiting lecturer in the Department of Economics and Commerce, 501
  Annual grant of £600 from Turner and Newall, Ltd , for a research fellowship in engineering, chemistry, physics, textile industries or any allied science, 502, 659
  Grant of £10,000 from the Nuffield Trust to establish a readership or senior lectureship in the Dental School, 502
  Grant of £1,500 a year for two years from the Bradford Dyers' Association, Ltd , for two research fellowships, 502
  Grant of £300 a year from the International Wool Secretariat for a wool research scholarship, 502
  Grant of 6,500 dollars from the Rockefeller Foundation for the purchase of equipment in connexion with Prof. W. T. Astbury's researches, 502
  Annual grant of £100 from Williams (Hounslow), Ltd., for equipment in the Colour Chemistry and Dyeing Department, 502
  Grant of £750 from Babcock and Wilcox, Ltd., for equipment in the Coal Gas and Fuel Industries Department, 502
  Grant from the Leverhulme Trustees to enable Prof. Whytlaw-Gray to devote himself to research, 659
  Offer by the Imperial Chemical Industries, Ltd , to finance and support research on the behaviour of gases, 659
  Gift by Charles Brotherton of £55,000 for a new chemical engineering laboratory, 659
  Appointment of Dr. J S. Forsyth as Brotherton lecturer in chemical engineering, 659
University of London . Retirement of Prof. Major Greenwood from the chair of epidemiology and vital statistics at the London School of Hygiene and Tropical Medicine, 43
  Appointment of A. L. L. Baker to the chair of concrete technology at the Imperial College of Science and Technology, 45
  Appointment of Prof. C Daryll Forde to the chair of anthropology at University College, 76
  Appointment of Raymond Irwin to the directorship of the School of Librarianship at University College, 108, 202
  Title of reader in bacteriology in the University conferred on J. C. Cruickshank, 108
  Conferments of the degree of D.Sc., 108, 533
  Appointment of Dr. D. H Hey to the chair of chemistry at the Imperial College of Science and Technology, 108
  Appointment of Dr F. C. Benham to the chair of commerce at the London School of Economics, 108
  Appointment of D. W. Harding to the chair of psychology at Bedford College, 108
  Retirement of Prof. E. H. Lamb from the chair of civil and mechanical engineering at Queen Mary College, 137
  Appointment of Dr. Edmund Giffen to the chair of civil and mechanical engineering at Queen Mary College, 137
  Retirement of Prof L Bairstow from the Zaharoff chair of aeronautics, 165
  Appointment of Dr John Yudkin to the chair of physiology at King's College of Household and Social Science, 202, 471
  Appointment of Dr. L Dudley Stamp to the chair of geography at the London School of Economics and Political Science, 202, 291
  Retirement of Prof. Ll. Rodwell Jones from the chair of geography at the London School of Economics, 291
  Appointment of J Z Young to the chair of anatomy at University College, London, 415
  Appointment of Prof G B. Jeffery as director of the Institute of Education, 443
  Appointment of Prof. Harold Davenport to the Astor chair of mathematics at University College, 443
  Appointment of Prof. F. G. Young to the chair of biochemistry at University College, London, 471
  Appointment of Dr A I. Richards to the University readership in anthropology at the London School of Economics, 533
  Appointment of Dr. Margaret Read to the University readership in education at the Institute of Education, 533
  Appointment of Dr. James Henderson as academic registrar, 533
  Appointment of Colonel S J. Worsley as principal of the College of Estate Management, 533
  Appointment of Dr. G. A. H. Buttle to the chair of pharmacology at the College of the Pharmaceutical Society, 566
  Title of University professor of electrical engineering conferred on Dr H E. M. Barlow, 566
  Title of University reader in analytical chemistry conferred on L. S. Theobald, 566
  Title of University reader in nutritional science conferred on Dr. Gladys A. Hartwell, 566
  Appointment of Dr. James Greig to the University chair of electrical engineering at King's College, London, 660
  Appointment of Dr. Kenneth Mellanby to the readership in entomology at the London School of Hygiene and Tropical Medicine, 712
  Appointment of Dr. Karl Mannheim to the University chair of education at the Institute of Education, 714, 743
  Appointment of Dr. Walter Freudenthal to the University readership in dermatological histology at University College Hospital Medical School, 714
  Title of professor emeritus in morbid anatomy conferred on Prof. G W. de P. Nicholson, 714
  Appointment of Prof D M Newitt to the Courtaulds chair of chemical engineering at the Imperial College of Science and Technology, 714, 774
  Appointment of Dr. Alan Moncrieff to the Nuffield chair of child health at the Institute of Child Health, 714
University of London Institute of Child Health : Appointment of Dr. Alan Moncrieff to the Nuffield chair of child health, 714
University of London Institute of Education : Appointment of Dr. Margaret Read to the readership in education, 533
  Appointment of Dr. Karl Mannheim to the chair of education, 714, 743
University of Manchester (Department of Chemistry) : Conference on Friedel-Crafts Catalysts and Polymerization, 232
University of Oxford : Honorary degree of D.C.L conferred on Sir D'Arcy Thompson, 17, 43
  Osler Medal for 1945 awarded to Dr. C. G. Douglas, 17
  Honorary degree of D Sc. conferred on Prof. H. M. Turnbull, 108
  Appointment of Prof. A. C. Hardy to the Linacre chair of zoology and comparative anatomy, 108, 200
  Appointment of Dr. O. R. Gurney as Shillito reader in assyriology, 140
  Appointment of G. E. Blackman as Sibthorpian professor of rural economy, 262
  Appointments in the Department of Forestry, 293
  Appointment of Archibald N Black as Donald Pollock reader in engineering science, 417
University of Sheffield : Appointments, resignations and retirements, 79
  Two scholarships for a full-time degree course in mining to be provided by the Yorkshire Mine Workers' Association, 79
  Retirement of Prof. R. N. Rudmose Brown from the chair of geography, 106
  Appointment of Squadron-Leader David L. Linton to the chair of geography, 106
  Appointment of L. Mirsky as assistant lecturer in mathematics, 473
  Appointment of Dr. J A Pope as lecturer in mechanical engineering, 473
  Resignation of Dr. E. T. Goodwin as lecturer in mathematics, of Dr. J. H. Read as lecturer in chemistry, of Dr. J. Shirley as lecturer in geology, of Dr. W. Davies as temporary lecturer in geology, of Colonel R. G. Bellamy as lecturer in mechanical engineering, and of Miss M C. Simpson as assistant bacteriologist, 473

  Appointment of P. C Sylvester-Bradley as assistant lecturer in geology, 745
  Appointment of Dr. H McIlwaine as lecturer in biochemistry, 745
  Resignation of Dr. A. Elliott as lecturer in physics, of Dr. J. C. Speakman as lecturer in chemistry, and of F. G. Hannell as lecturer in geography, 745
University College of Wales, Aberystwyth : Appointments in the newly formed Department of Animal Health, 331
University College, Dublin : Appointment of Dr. T. S Wheeler to the chair of chemistry, 230
University College, Hull : Appointment of Paul G. 'Espinasse as lecturer and head of the Department of Zoology, 777
University College, London · Appointment of Prof. C. Daryll Forde to the University of London chair of anthropology, 76
  Appointment of Raymond Irwin to the directorship of the School of Librarianship, 108, 202
  Appointment of J. Z. Young to the University of London chair of anatomy, 415
  Appointment of Prof. Harold Davenport to the Astor chair of mathematics, 443
  Appointment of Prof. F. G. Young to the University of London chair of biochemistry, 471
  Re-opening of the Department of the History and Philosophy of Science, 532
  Title of University of London professor of electrical engineering conferred on Dr. H. E. M. Barlow, 566
University College Hospital Medical School . Appointment of Dr. Walter Freudenthal to the University of London readership in dermatological histology, 714
University Professors and Lecturers of the Allied Countries in Great Britain, Association of : Some Comparisons between Universities (Proceedings of the Second Education conference), 183
University Teachers, Association of : Second Report on University Developments, 311
Urwick, Colonel L. : Compromise and Integration, 93
U S.S.R , Academy of Sciences of the . Conference on Viscosity of Liquids and Colloidal Solutions, 147
  220th Anniversary Celebrations, 221
  Election of Academician Sergei Vavilov as president, 230
  (Astronomical Institute of the) · Ephemerides for the Determination of Time Corrections by Equal Altitudes (Zinger's Method) for 1944, 16
  . Annuaire astronomique de l'URSS pour l'an 1944, 17
U S.S.R., All-Union Scientific Research Institute of Plant Industry of the : Return to Leningrad, 745
U.S.S R., Medical Academy of the : Election of first members, 714
Uvarov, Dr. B. P. : *Obituary* of Don Ignacio Bolivar y Urrutia, 74

VALENTINE, Prof. C. W · Intelligence Tests for Young Children, *review* by Dr John Cohen, 349
Valentine, Dr. David H. : Appointed to the readership in botany in the Durham Colleges, 140
Valiron, Prof. Georges . Théorie des fonctions, *review* by Prof. H. T. H. Piaggio, 648
Van Geluwe, J D (Hoffman, M B., and) : Biennial Bearing of Apple Trees, 304
Van Itterbeek, Prof. A , and De Greve, L. Resistivity of Thin Metallic Films, 634
Van der Klaauw, Prof. C. J. : Letter to Dr. Julian Huxley, 166
Vandenbelt, Dr J. M. : Nutritive Value of Coco-nut, 174
Vanderplank, F L. Insecticidal Properties of *Euphorbia* Extracts, 782
Vanderplank, F L. (Potts, W H , and) · Mode of Entry of Contact Insecticides, 112
Varela, Prof. M. E : Human Chromosomes, 755
Varley, G C. (Lack, David, and) . Detection of Birds by Radar, 446
Vassilieva, L V., and Rosental, I. S . Research on Conditioned Reflexes, 455
Vaucher, Prof. · Some Comparisons between Universities, 183
Vaughan, Thomas Wayland : Awarded the Mary Clark Thompson Medal of the United States National Academy of Sciences, 575
Vaughan, Dr William E., and others Halogenation in the Allyl Position, 53
Vavilov, Academician Sergei · Elected president of the Academy of Sciences of the U S S.R., 230 ; work of, 230
Vavilov, Academician Sergei, and others · *Obituary* of Prof. L. I. Mandelstam, 105
V.D. Orderly : People Who Live in Glass Houses, 501
Vejdovský, Prof F. : *Obituary* by Dr Clifford Dobell, 530
Venkateswarlu, P. (Asundi, Prof. R K., and) · Emission Bands of the Fluctuation Type in the Spectrum of Iodine, 452
Venn, Dr J A. (compiled by) : Alumni Cantabrigienses, Part 2, From 1752 to 1900, Vol 2, Chalmers—Fytche, *review* by Prof. F. J. M. Stratton, 348
Vergara, Dr. Hipólito, and others Fluorescence Microscopy of Tubercle Bacilli, 16
Vermeil, Prof. E. : Some Comparisons between Universities, 183, 184
Vernon, Dr. W H. J. : The Corrosion of Metals, 435
Veterinary Educational Trust : Awards, 45, 473
Virtanen, Prof Artturi : Awarded the Nobel Prize for 1945 for chemistry, 714
Visiting Scientists, Society for : Meetings to discuss the organisation of research within the British Commonwealth, 660, 758
Vlodavetz, V. I : Volcanological Station at Kamchatka, 640
Vrba, Karel (1845–1922), 598
Vuskovic; Sr. Nicolás, and others : Fluorescence Microscopy of Tubercle Bacilli, 16

WADDINGTON, Dr C H . Appointed to the scientific staff of the Agricultural Research Council, 231
  The Early Human Embryo, *review*, 375
  Self-sufficient Biology, *review*, 731
  Organisation of Scientific Research in the British Commonwealth, 758
Wager, Prof. L. R., and Mitchell, R. L Distribution of Vanadium, Chromium, Cobalt and Nickel in Eruptive Rocks, 207
Wain, R L. (Martin, H , and) : Phytopathological Uses of the new Insecticide D.D.T., 168
Walker, James, and others Antimalarial Activity of Tetrahydroacridones and related Substances, 629
Wallace, Prof. T., and others : Determination of Factors Injurious to Plants in Acid Soils, 778
Walls, D., and others A Theory of the Formation of Hydrochloric Acid in the Gastric Mucosa, 477
Walton, Dr. Arthur (Tošić, J , and) . Respiration of Spermatozoa in Egg-Yolk Medium, 507
Warburg, Prof. Otto : Message to Prof. H. A. Krebs from Dr. T. Bücher concerning, 714
Ward, Dr. A. M. : Appointed principal of the Sir John Cass Technical Institute, 445
Wardlaw, Prof C W. : An Experimental Treatment of the Apical Meristem in Ferns, 39
Warner, R. C. · Separation of Casein, 179
Waters, Dr. W. A. . Halogenation in the Allyl Position, 53
Waterton, F. W. (Meek, Dr. J. M., and) : Measurement of High Voltages, 422
Watson, Prof. D. M. S. . Archæological Exploration in South Africa, 55
  Vertebrate Palæontology in the U.S.S.R., 225
  Obituary of Dr. J. C Merriam, 683
Watson, Prof. G. N. . A Treatise on the Theory of Bessel Functions, second edition, *review* by Prof. L. M. Milne-Thomson, 190
Watson, T. Y. : Appointed senior agricultural officer, Kenya, 264
Watson-Watt, Sir Robert : Science and Education, 56
  Radar in War and in Peace, 319
  The Inter-relations between the Natural and Social Sciences, 652
Watts and Son, Ltd , E. R., the Coventry Gauge and Tool Co , Ltd., and Taylor, Taylor and Hobson, Ltd. . To co-operate in the development and distribution of precision engineering and optical equipment, 387
Weil, Robert : An Illusion of Size, 636
Weir, Sir Cecil : Penicillin Production in Great Britain, 386
Weisbach, Prof. W. . Now sole owner of the publishing firm of Dr. W Junk, 687
Weiss, Prof. F. E. : Eightieth Birthday celebrations by the Linnean Society, 500
Weiss, Dr. J (Offord, A. C., and) : Chromatography of Two Solutes, 570
Weizmann, Prof. Chaim : Presented with a volume of researches by members of the Division of Plant Pathology of the Agricultural Research Station, Rehovoth, Palestine, on the occasion of his seventieth birthday, 713
Welding, G. N. (Buist, J. M , and) : Use and Misuse of Accelerated Ageing Tests, 10
Welding, Institute of Sir William J. Larke Medal for 1945 awarded to W. K. B. Marshall, 473
  Prize Awards, 473
Wellcome Historical Medical Museum : Appointment of Dr. E. Ashworth Underwood as director, 416
Wellcome Museum of Medical Science : Appointment of Wing-Comdr C. J. Hackett as director, 416
Wells, Dr. A. F. · Indexes of Data for Identification Purposes, 535
Wells, Dr. John W : Some French and German Geographical and Geological Institutions, 243
Welten, Max : Pollenanalytische, stratigraphische und geochronologische Untersuchungen aus dem Faulenseemoos bei Spiez, 383
Went, Arthur E. J. : Previously Spawned Salmon in Irish Rivers, 178
Wenyon, Dr. C. M. : Awarded the Theobald Smith Gold Medal of the American Academy of Tropical Medicine, 473
Werkman, C. H. (edited by Nord, F. F., and) Advances in Enzymology and related Subjects of Biochemistry, Vols. 4 and 5, *review* by Dr. J. H. Quastel, 611
Wertenstein, Prof. L. : *Death* of, 290 ; *obituary* by Dr J Rotblat, 384
Wertheimer, E. (Shapiro, B , and) Acetylphosphatase in Animal Tissues, 690
West, Dr. T. F., and others . Efficacy of D D T. in Soap, 749
West of Scotland Field Studies Council : Inauguration of the, 331
Westland Aircraft Co. : Production of the Westland 'Welkin' stratosphere fighter, 44
Wettstein, Prof. F. von · *Obituary* by Dr. F. W. Sansome, 328
Wheeler, Hilda H : Effect of High Vitamin A in the Diet of Domestic and Non-Domestic Animals, 238
Wheeler, Dr. T. S. : Appointed to the chair of chemistry in University College, Dublin, 230 ; work of, 230
Whipple, R. S. : *Obituary* of Major C E. S. Phillips, 228
White, A. G. Hastings : *Death* of, 42 ; *obituary* by Sir Henry Dale, 228
White, C. M. : Degree of D.Sc (Eng) in the University of London conferred on, 533
White, Dr. James : Appointed lecturer in refractory materials in the University of Sheffield, 79
White, Prof. R G. : Appointed to the scientific staff of the Agricultural Research Council, 231
Whitehead, Dr. S . The Corrosion of Metals, 435
Whitehead, T. H. · Appointed director of the Geological Survey (Scottish Office), 743 ; work of, 743
Whitnall, A. B. M. (Omer-Cooper, Prof. J., and) . An Arsenic-Resistant Tick, 450
Whitrow, G. J. : The Two-body Problem in Milne's Theory of Gravitation, 365
Whittingham, Dr. G. · Influence of Sulphur Oxides on the Luminosity of Coal Gas Flames, 207
Whytlaw-Gray, Prof. Robert W · Retirement from the chair of chemistry in the University of Leeds, 386 ; work of, 386
  Title of emeritus professor in the University of Leeds conferred on, 501
  Awarded a grant by the Leverhulme Trustees to devote himself to research, 659
Wiedling, Sten A Thermostabile, Fungistatic Factor from *Escherichia coli*, 204
Wieland, Dr. K. : Thermal Decomposition of $HgCl_2$ Vapour, 504
Wiener, Dr. Alexander S. · Awarded the Alvarenga Prize for 1945 of the College of Physicians of Philadelphia, 79
Wiggins, Dr. L. F., and others : A Constitutional Synthesis of Chondrosamine, 308
Wigglesworth, Dr. V. B. . Appointed to the readership in entomology in the Department of Zoology, Cambridge, 712 ; work of, 712

Wilhelm, H T. · Impedance Bridge with a 10^8 to 1 Range, 639
Wilkins, H. Percy · New Map of the Moon, 501
Wilkinson, Flight-Sergt. Martin : Acoustic Control in the Flight of Bats, 693
Wille, Prof. Johannes, and others : Control of Internal Boll Rot of the Cotton Plant, caused by Insect Punctures (*Dysdercus* sp.), through Selection of Resistant Strains, 235
Williams (Hounslow), Ltd. : Annual Grant of £100 to the University of Leeds for equipment in the Colour Chemistry and Dyeing Department, 502
Williams, Prof. E. J. : *Death* of, 415 ; *obituary* by Prof. P. M. S. Blackett, 655
Williams, P. C. (Smith, A E. Wilder, and) : Instability of Dienœstrol and Stilbœstrol Solutions, 718
Williams, Prof. Robley C., and Wyckoff, Dr. Ralph W. G. : Electron Shadow-Micrographs of Hæmocyanin Molecules, 68
Williams, Van Zandt, and others : Infra-red Spectroscopy, *review* by Dr. H. W. Thompson, 65
Willmer, E N., and Wright, W. D. : Colour Sensitivity of the Fovea Centralis, 119
Willmore, Dr. T. J. · Clock-Regraduations and Relativistic Cosmology, 748
Wills, Dr. Lucy . The Vitamin B Complex in Anæmia, 87
Wilmott, A. J. . Acoustic Control in the Flight of Bats, 687
Wilson, Dr. A. R , and others : Control of Dry Rot of Seed Potatoes by Dusting, 394
Wilson, Dr. Cecil L. : The Teaching of Analytical Chemistry in Great Britain, with special reference to Microchemistry, 588
Wilson, D. G (Pollak, Dr. H., and) : Absolute and Differential Light Sensitivity of the Dark-adapting Eye, 299
Wilson, Group-Captain H. J. . Air Speed Record by Jet Propelled Aircraft, 597
Wilson, J. A. : Agricultural and Forestry Economy of Madras, 151
Wilson, Prof. J. T. . *Death* of, 290 ; *obituary* by Dr. H. L. H. H Green, 772
Wilson, Malcolm, and others : Blind Seed Disease of Rye-grass, 178
Wilson, Dr. M E. : Awarded the Willet G. Miller Medal of the Royal Society of Canada, 271
Wilson, W. (Hartshorn, Dr. L., and) : An Electrical Moisture Meter, 16
Winckworth, R. : *Obituary* of Dr. P. Pelseneer, 136
Winster, Lord : Men of Science in the Modern State, 231
Winterbottom, A B. : The Corrosion of Metals, 438
Witchell, Prof. E. F. D. : The City and Guilds College—Engineering at the Imperial College, 650
Wodehouse, Roger P. : Hay-fever Plants, *review* by Dr. H. Godwin, 317
Wolff, Eugene · A Pathology of the Eye, second edition, *review*, 279
Wolters, Prof A. W. : The Concept of Mental Maturity, 494
Wood Jones, Prof. F. : *Obituary* of Dr. G V. Buchanan, 385
Woodson, Weldon D. (Thorp, Raymond W., and) . Black Widow, America's Most Poisonous Spider, *review* by T. H. Savory, 253
Woodward, Miss L (Ubbelohde, Dr. A R., and) : Laue Photographs of Sub-crystalline Regions in 'Hybrid' Crystals of Potassium Dihydrogen Phosphate, 20
Wool Secretariat, International Grant of £300 a year to the University of Leeds for the establishment of a Wool Research Scholarship, 502
Woolley, Lady : *Death* of, 623
Woolton, Lord · Statistics in the Modern State, 686
Wooster, Dr. W. A. Crystallography in the U S S.R., 256
Work, T. S. (Tonkin, Isabel M., and) · A New Antimalarial Drug, 630
World Power Conference : Meeting of the International Executive Council of the, 660
Worsley, Colonel S. J. : Appointed principal of the University of London College of Estate Management, 533
Worthington, Dr. E. B. : Organisation of Scientific Research in the British Commonwealth, 758
Wright, Basil . Film Production, 426
Wright, Prof. C. E. · *Death* of, 596 ; *obituary* by Prof. C. J. Tranter, 742
Wright, 'AC.2 E. N , and others : Mass Departure of Locust Swarms in relation to Temperature, 628
Wright, J. E. . Manual of Special Library Technique, *review* by R. Brightman, 406
Wright, W. D. (Willmer, E. N., and) : Colour Sensitivity of the Fovea Centralis, 119
Wul, Dr. B. : Dielectric Constants of some Titanates, 480
Wunderly, Ch : Differentiation of Nuclear Substances, 750
Wyatt-Smith, J., and others . Need for Development of Tropical Ecological Studies, 627
Wyckoff, Dr. Ralph W. G. (Williams, Prof. Robley C., and) : Electron Shadow-Micrographs of Hæmocyanin Molecules, 68
Wyllie, G. A. P. : Units for Degree of Vacuum, 85

YAKOVIEVA, V. V. : Research on Conditioned Reflexes, 455
Yakovleva, E. A. . Research on Conditioned Reflexes, 455
Yale University School of Medicine · Reports for the Years 1941–44 of the Historical Library, 27
Yang, Fu-hsi (Li, Dr. Fei-pai, and) . A Medium for Mounting Parasitic Helminths, 297
Yapp, Bridget J., and others : An Introduction to Child Guidance, *review* by Dr. Alan Maberly, 157
Yarnold, Dr G. D., and Heath, L : Lantern Slides of Line Drawings, 574
Yeo, D., and others . Mass Departure of Locust Swarms in relation to Temperature, 628
Yorkshire Mine Workers' Association : To provide two scholarships for a full-time degree course in mining at the University of Sheffield, 79
Young, Prof. F. G . Appointed to the chair of biochemistry at University College, London, 471 ; work of, 471
Young, J. Z. . Structure, Degeneration and Repair of Nerve Fibres, 132 . Appointed to the University of London chair of anatomy in University College, London, 415
Young, L. : Degree of D.Sc. of the University of London conferred on, 108
Yudkin, Dr. John · Appointed to the University of London chair of physiology at King's College of Household and Social Science, 202, 471 ; work of, 471
Yudkin, Dr. John (Pulvertaft, Lieut.-Colonel R. J. V., and) · Stabilization of Penicillin Solutions by Phosphate, 82

ZERNOV, S. A , and Schmalhausen, O. I. : Low-Temperature Limits of Life, 304
Zeuner, Dr. Frederick E. : The Pleistocene Period, its Climate, Chronology and Faunal Successions, *review* by Sir George Simpson, 730
Zohary, Prof. · Plant Studies in Syria, 246
Zwarenstein, Dr. H. (Duncan, D. G., and) : Congo Red Fibrin Powder for Experiments on Proteolytic Enzymes, 112

SUBJECT INDEX

ABERDEEN · Earthquakes registered during the First Quarter of 1945, 264
Abstracting Service for Human Biology, 714
Accounting · Good Farm (A. C Campbell), *review*, 764
2-Acetyl-amino-fluorene : Glioma in a Rat Fed with (Dr. E. Vazquez Lopez), 296
Acetylphosphatase in Animal Tissues (B. Shapiro and E. Wertheimer), 690
Achievement : British, in the Art of Healing (John Langdon-Davies), *review* by Dr. G. Lapage, 350
Acid Soils : Determination of Factors Injurious to Plants in (Prof. T. Wallace, E. J Hewitt and D. J. D. Nicholas), 778
Acid-fast Bacteria : Inhibitory Action of Dialkyl Succinic Acid Derivatives on the Growth *in vitro* of (Vincent C. Barry and Dr P. A McNally), 48
Acids (Fatty) : Lubrication of Metal Surfaces by (Dr F. P. Bowden, J. N. Gregory and Dr. D. Tabor), 97
Acoustic Control in the Flight of Bats (Prof. H Hartridge), 490, 692 ; (A. J Wilmott), 687 , (Dr D. W. Ewer), 692 ; (Flight-Sergt Martin Wilkinson), 693
Acquired Characteristics : Inheritance and (Prof. Wm. Rowan), 236
Actinomycetes (Meredith's) : Inhibition of the Development of *Fusarium oxysporum cubense* by a Growth Substance produced by (Dr. A. C. Thaysen and K. R. Butlin), 781
Activation Energy of Ionic Migration in Molten Salts (Dr E. Heymann and H. Bloom), 479
Activity of the Respiratory, Vasomotor and Cardio-Regulatory Centres : Influence of Blood Pressure and Blood Flow on the (Prof. C. Heymans), 750
Adenosine Triphosphate . Synthesis of, by an Enzyme System from Ischæmic Muscle (Marian Bielschowsky and Prof. H. N. Green), 117
Administration : Technology and, 671
Administration in Germany : A Plan for Decentralizing, *review* by Prof. W. Fitzgerald, 253
Adsorption of Enzymes on Solid Nucleic Acid (Dr. J. A. V. Butler), 781
Adsorption of Water Vapour by Wheat : Hysteresis in the (Dr J. D. Babbitt), 265
Adsorption Isotherms from Chromatographic Measurements (Dr. E. Glückauf), 748
Adults (Human) : Vitamin A Deficiency and the Requirements of, 11
Advertising : The Economics of (F P. Bishop), *review*, 765
Aerial Bactericides (J E. Lovelock), 782
Aerial Survey in Peace-time . R A F., 2
Aerial Unit for Scientific Work : Memorandum on the Establishment of an (British Ecological Society), 2
Aeronautical Engineering at Bristol, 43
Africa (East) · The Stone Age in (M C Burkitt), 371
  A Contribution to the Study of the Tumbian Culture in (Dr. J. B. S. Leakey and Archdeacon Owen), 371
Africa (East and West) . The Contribution of Colonial Geological Survey to the Development of the Mineral and other Resources of (Sir Edmund Teale), 167
Africa (South) . Archæological Exploration in (Prof. D. M. S Watson), 55
  The Constitution of the Intertidal Fauna and Flora of (Prof. T A. Stephenson), Part 2, 27
  Marine Ecology in, 27
Africa (West) : Report of the Commission on Higher Education in, 345
African Fermented Foods : B Vitamins in (Dr. Leon Golberg, J M. Thorp and Sheila Sussman), 364
African (South) Onychophora (Dr. S. M. Manton), 338
Afterglow Effects in High-Pressure Gases (Dr. J D. Craggs and Dr. J. M. Meek), 21
Age-hardened Alloys : Striated Structure of (Dr M. L. V. Gayler), 333
Ageing : Heat, of GR-S Vulcanisates (Dr J. R. Scott), 10
Ageing Tests (Accelerated) . Use and Misuse of (J. M. Buist and G. N. Welding), 10
Aggregates (Crystalline) · High Permittivity (Prof. Willis Jackson and W. Reddish), 717
Agricultural Attaché at Washington and Agricultural Adviser at Ottawa : Appointment of A. N Duckham as, 138
Agricultural Engineering Record . To recommence publication by the National Institute of Agricultural Engineering, 232
  Publication of No. 1 of the, 500
Agricultural and Forestry Economy of Madras (J A. Wilson), 151
Agriculture : European (United Nations Relief and Rehabilitation Administration), 15
Agrochemistry in the U S.S.R. (Dr E. M. Crowther), 227
Air Navigation : Astronomical (Squadron-Leader Ronald Hadingham), second edition, *review*, 489
Air Photography : Recent Developments in (Wing-Comdr. H. Hamshaw Thomas), 409
Air Photography in the Far East (Dr. V. J Chapman), 604
Air Speed Record by Jet Propelled Aircraft (Group-Captain H. J. Wilson), 597
Aircraft · New Stratosphere, 44
Aircraft Workers Education and Training of, 78
Albumin (Human Serum) : Heterogeneity of (H. Hoch and C. J. O. R. Morris), 234
Alcohol : Synthetic Rubber from (Anselm Talalay and Michael Magat), *review* by Dr. W. J. S. Naunton, 251
Alcohol Vapour · Effect of the Pressure of, on the Operation of the Fast Geiger-Muller Counter (Dr G. D Rochester and C. B. A McCusker), 366
Aldan Region, Eastern Siberia : Post-Jurassic Intrusions of the (Y. A. Bilibin), 178
Algæ and Grasses Californian Marine, 533
Algal Tissues for Microtome Sections : Use of Hydrochloric Acid for Softening (Dr. Kathleen M. Drew), 479
Alkali Halides in Borax and B_2O_3 Glass Systems : X-Ray Study of the Solution of (S. K. Majumdar, B. K. Banerjee and K. Banerjee), 423
Allied Plan for Education (Dr. E. F. Armstrong), 708
Allotropic Modifications of Diamond (Sir C. V. Raman), 22
Alloys (Age-hardened) : Striated Structure of (Dr. M. L. V. Gayler), 333
Allyl Position : Halogenation in the (Dr. William E. Vaughan, Frederick F. Rust and George W Hearne), 53 ; (Dr. W. A Waters), 53
Alpha-Ray Bombardment · Effect of, on Glide in Metal Single Crystals (Prof. E. N da C. Andrade), 113
Aluminium Conductors (Steel-Cored) : Tensile Load on (E. W. W. Double), 305
Aluminium Halides with the Xylenes : Interaction of (H. Campbell and E. F. G. Herington), 389
Alumni Cantabrigienses (Compiled by Dr. J. A. Venn), Part 2, From 1752 to 1900, Vol. 2, Chalmers—Fytche, *review* by Prof F. J. M. Stratton, 248
Alvarenga Prize for 1945 of the College of Physicians of Philadelphia awarded to Dr. Alexander S. Wiener, 79
America (Latin) · Plants and Plant Science in (edited by Frans Verdoorn), *review*, 676
America (South) : The Race Problem in, *review* by Prof A. R. Radcliffe-Brown, 158
American Clingfishes (L P. Schultz), 304
American Work on the Atomic Bomb Project (Prof. N. Feather), 768
Américas · El Indoamericanismo y el Problema Racial en las (Prof. Dr. Alejandro Lipschutz), segunda edicion, *review* by Prof. A. R. Radcliffe-Brown, 158
Amino Acid Composition of Proteins and Foods (Dr. Richard J. Block and Diana Bolling), *review*, 33
Amino-Acids and Peptides : Proteins, as Ions and Dipolar Ions (Edwin J. Cohn and John T. Edsall), *review* by Dr. Kenneth Bailey, 405
p-Aminobenzoic Acid : Production of, by the Tubercle Bacillus (Torsten Ekstrand and Bertil Sjogren), 476
Amino-quinazolines (Prof. A. Killen Macbeth and Harold J. Rodda), 207
Ammonia : Rate of Entrance of, into Muscle Fibres in relation to Carbon Dioxide Tension (Prof. E. J. Conway and P. T. Moore), 270
Amœbiasis in Durban (Major R. Elsdon-Dew), 118
Amyloid-Congo-Red-Complex in Histological Sections : Double-Refringence of the (Dr Peter Ladewig), 81
Anæmia . The Vitamin B Complex in (Dr. Lucy Wills), 87
Anærobic Metabolism of Spermatozoa (Dr T. Mann), 80
Analysis Colorimetric (Noel L Allport), *review* by A. L. Bacharach, 434
  Spectral, of Solid Substances (Dr. J. Eeckhout), 175
Analyst, The : Retirement of Dr. C Ainsworth Mitchell from the editorship, 443
  Appointment of J. H Lane as editor, 443
Analysts · Colour for, *review* by A. L. Bacharach, 434
Analytical Chemistry in Great Britain, with special reference to Microchemistry . The Teaching of (Dr. Cecil L Wilson), 588
Angiosperms . Origin of Haploid-Diploid Twin Embryos in (Dr. P. Maheshwari), 173
  Embryology of, as a Field for Research (Dr. P. Maheshwari), 354
Anglesey : Iron Age Finds from (M. C Burkitt), 309
Anglo-French Conference on Cosmic Rays, 140, 543
Animal in Health, *review* by Dr. John Hammond, 377
Animal Behaviour . Classification and Nomenclature of (Dr. J. S. Kennedy), 754
Animal Breeding and Genetics in Great Britain : Research in, 231
Animal Cells : Demonstration of Mitosis in (Dr. W. S. Bullough), 574
Animal Learning and Evolution (Dr. W. H. Thorpe), 46
Animal Organ Extracts · A Sympathomometic Pressor Substance in (Prof. U. S v Euler), 18
Animal Tissues · Acetylphosphatase in (B. Shapiro and E. Wertheimer), 690
Animals (Domestic and Non-Domestic) : Effect of High Vitamin A in the Diet of (Hilda H. Wheeler), 238
Animals (Farm) : Physiology of (Dr. F H. A Marshall and E. T. Halnan), third edition, *review* by Dr. John Hammond, 377
Anion Permeability Constants : Cation and, for the Muscle Fibre Membrane (Prof. E. J. Conway and P T. Moore), 170
Annual Register for the Year 1944 (edited by Dr. M Epstein), *review*, 489
Anodic Deposit of Protactinium (M. Haïssinsky), 423
Anomalous Inactivation of Heavy Metal Antifouling Paints (Prof. John E. Harris), 206
Antarctic Discoveries : United States (Prof. R. N. Rudmose Brown), 399
Anthropologist · The Posthumous Testimony of an, *review* by Dr. C. S. Myers, 218
Anthropology . Essays in, Presented to Rai Bahadur Sarat Chandra Roy (edited by J. P. Mills, B S. Guha, K. P. Chattopadhayay, D. N. Majumdar and A. Aiyappan), *review* by Prof. J. H. Hutton, 66
  Archæology and, in the U S.S.R (Prof. V. Gordon Childe), 224
Anthropology of Portuguese Timor, *review* by Prof. A. R. Radcliffe-Brown, 129
Anti-bacterial Action of 'Polyporin' against Typhoid, Cholera, Dysentery and *B. coli* (Prof. S. R. Bose), 171
Antibiotic Action : Early Observation of (C. N. Davies), 666
Antibiotic Substance in the Chinese Water-chestnut, *Eleocharis tuberosa* (S. L. Chen, B. L. Cheng, W. K. Cheng and P. S. Tang), 234
Antibiotics : Two New (Dr. G. Lapage), 398
Antibiotics from Moulds (J. Kent and N. G. Heatley), 295
Antibodies : Antigens and, *review* by Capt. J. A. R. Miles, 348
Anti-Chromatic Reflex (Prof. H. Hartridge), 666

Antifouling Paints (Heavy Metal) · Anomalous Inactivation of (Prof. John E. Harris), 206
Antigens and Antibodies, *review* by Capt J. A. R. Miles, 348
Anti-*Hr* Sera (Dr. Philip Levine), 418
Anti-Lewisite (*BAL*) . British (Prof R A Peters, Dr. L. A Stocken and Dr. R. H. S. Thompson), 616
Antimalarial Activity in Tetrahydroacridones and related Substances (Joan M. L. Stephen, Isabel M. Tonkin and James Walker), 629
Antimalarial Drug . A New (Isabel M. Tonkin and T. S. Work), 630
Antimalarial Properties in Quinine Degradation Products · Loss of (P. B. Marshall), 505
Apical Meristem in Ferns : An Experimental Treatment of the (Prof. C W. Wardlaw), 39
Apogonid Fish from New Jersey : Description of a New Genus and Species of (Henry B. Fowler), 395
Apple Drop following Frost : Use of Growth-Promoting Substances in the Prevention of (T. Swarbrick), 691
Apple Trees . Abnormal Lignification in the Wood of some (Dr. A. Beryl Beakbane and Dr. Eleanor C. Thompson), 145 ; *erratum*, 202
  Biennial Bearing of (F. S. Howlett), 304 , (A. B. Burrell), 304 ; (A V. Doren and M. B. Hoffman), 304 ; (M. B Hoffman and J. D Van Geluwe), 304 ; (A E Murneek), 304
Apprenticeship for a Skilled Trade (F. Twyman), 155
Arabian Sea : Earthquake on November 27, 712
Archæological Exploration in South Africa (Prof. D. M. S Watson), 55
Archæology and Anthropology in the U.S.S.R (Prof. V. Gordon Childe), 224
Archaic Fishes · Completion of the Bashford Dean Memorial Volume on (Dr. E. W. Gudger), 533
Archives of the Lakes (Dr. H. Godwin), 383
Argentine-British Medical Centre established in Buenos Aires, 107
Aristotelian Society Proceedings of the, New Series, Vol. 44, Session 1943–1944, *review* by Prof. A. D. Ritchie, 33
Aristotle's Criticism of Plato and the Academy (Harold Cherniss), Vol. I, *review* by Prof A. E. Taylor, 647
Army Education—Educating the Educators, 513
Army School of Education, Eltham Palace (Major T. H Hawkins), 527
Aromatic Nitration ? · Univalent Electron Transfers in (G. A. Benford, C. A. Bunton, E. S. Halberstadt, Dr. E. D. Hughes, Prof. C. K Ingold, G. J Minkoff and R. I. Reed), 688
Arsenic-Resistant Tick (Prof J. Omer-Cooper and A. B. M. Whitnall), 450
Art Galleries as a National Service · Museums and, 249
Arterial Injuries (Medical Research Council, War Memorandum No. 13), 362
Arts and Crafts of the Cook Islands (Mrs. K. Rishbeth), 61
Arylcarbamic Esters and related Compounds · Effect of some, upon Cereals and other Plant Species (Dr. W. G. Templeman and Dr. W A. Sexton), 630
Astronomical Air Navigation (Squadron-Leader Ronald Hadingham), second edition, *review*, 489
Astronomy and Terrestrial Magnetism in the U S S R (Sir Harold Spencer Jones), 324
Astrophysics : Physics and, at the Imperial College (Prof. Herbert Dingle), 562
Atmospheric Oxygen (Earth's) · Stability of the (Alfred Lauck Parson), 504
Atom . Time, Number and the (R. Fortescue Pickard), *review* by F. J. Garrick, 489
Atomic Bomb, 382
  Statements relating to the, 768
Atomic Bomb Project . American Work on the (Prof N Feather), 768
Atomic Co-ordinates Derived from Fourier Systems : Accuracy of (A. D. Booth), 51
Atomic Energy, 609, 768
  Advisory Committee on, 262
  Research in Britain on, 531
  Three-Power Declaration on, 615
Atomic Energy, an International Responsibility, 153
Atomic Energy as a Human Asset (Dr Arthur H. Compton), 687
Atomic Energy and its Implications (joint meeting of the American Philosophical Society and the U.S. National Academy of Sciences on), 687
Atomic Energy for Military Purposes · A General Account of the Development of Methods of Using, under the Auspices of the United States Government, 1940–1945 (Prof. H. D. Smyth), 768
Atomic Energy and Scientific Freedom, 564
Atomic Energy and Its Utilization, 547
Atomic Nuclei (Heavy) · Penetration of Fast Nucleons into (Prof. L. Rosenfeld), 141
Atomization of Carbon : Energy of the Hg—C Bond and the Heat of (Prof. N. V. Sidgwick and H. D Springall), 599
Australia · The Application of Science to Industry in (Sir David Rivett), 472
Automatic Controlling and Recording of Chemical and other Processes : Instruments for the (Institution of Chemical Engineers, the Institute of Physics, and the Chemical Engineering Group of the Society of Chemical Industry joint conference on), 45, 723
Autotrophic Flagellates as the Major Constituents of the Oceanic Phytoplankton (Dr. W. R. G. Atkins), 446
Autoxidation of Linoleic Acid (Sune Bergstrom), 717
Avoidance of Obstacles by Bats (Prof. H. Hartridge), 55

BACILLUS (Tubercle) · Production of *p*-Aminobenzoic Acid by the (Torsten Ekstrand and Bertil Sjogren), 476
Bacteria in relation to the Milk Supply (G. H. Chalmers), third edition, *review*, 406
Bacteria (Acid-fast) . Inhibitory Action of Dialkyl Succinic Acid Derivatives on the Growth *in vitro* of (Vincent C. Barry and Dr. P. A. McNally), 48
Bacteria (Legume Nodule) . Effective and Ineffective Strains of (Dr. H. G. Thornton), 654
Bacterial Virus Mutations in (S. E. Luria), 304
Bactericides : Aerial (J E. Lovelock), 782
Bacteriological Purposes Preparation of Silicic Acid Jellies for (Bjorn Ingelman and Ingvar Jullander), 572
Bacterium brunneum · Cultures of (William J. Ellis), 365
Bacterium coli : Effect of Sulphanilamide on the Sugar Consumption of (N. Klissiunis), 178
Bacterium coli (Typhoid, Cholera, Dysentery and) . Anti-bacterial Action of 'Polyporin' against (Prof S. R. Bose), 171
Ball Lightning, 293
Baly Medal of the Royal College of Physicians awarded to Prof S. A. S Krogh, 531
Barium Titanate : Crystal Structure of (W F. Forrester and R. M. Hinde), 177
Barley Grain · Some Factors concerned in the Process of Starch Storage in the (H K Archbold), 70
Barley Seedlings on Very Acid Soil Accumulation of Sugars in (T W. Barnes), 692
Bat : Unusual State at Birth of a (T. S. Jones), 365
Bates Method for Good Sight without Glasses (Dr. William H. Bates), *review*, 281
Bats : Acoustic Control in the Flight of (Prof H. Hartridge), 490, 692 ; (A. J. Wilmott), 687 ; (Dr. D. W. Ewer), 692 , (Flight-Sergt. Martin Wilkinson), 693
  Avoidance of Obstacles by (Prof. H Hartridge), 55
Bearded Iris Seeds . Germination of (L F. Randolph and L. G. Cox), 395
Beckmann Rearrangement . Mechanism of the (Flight-Lieut. Bryan Higman), 242 ; (M J S. Dewar), 688
Beetles (Powderpost) · Protection of Timber against, 16
Behaviour of the Common Centipede *Lithobius forficatus* (Capt. J. L. Cloudsley-Thompson), 537
Beit Memorial Fellowships for Medical Research : Annual Report of the Trustees for the Year 1944–45, 140
  Elections, 140
Belgian Biological Publications during the War, 166
Belgique : Léon Fredericq et les débuts de la physiologie en (Prof. Marcel Florkin), *review* by Prof. C. Lovatt Evans, 764
Belgique pendant l'occupation Allemande 1940–1944 : Les états de carence en (Lucien Brull, G. Barac, T. Brakier-Zelkowicz, P. Clemens, R. Crismer, J. Deltombe, A. Divry, L. Dubois, L. Dumont, L. Dumont-Ruyters, A. Lambrechts, R. Neuprez, A Nizet, M -J. Op de Beeck, J Piersotte et A. Thomas), *review* by Major J Marshall, 551
Belgium : Deficiency Diseases in, *review* by Major J. Marshall, 551
Bengal · Artificial Production of Ergot in the Tropical Plains of (J. C. Saha and S. K. Bhattacharjee), 363
Benzene . Near Ultra-Violet Emission Bands of (Prof. R. K. Asundi and M. R. Padhye), 368 ; (Prof. C K. Ingold), 569
Benzidine and related Rearrangements . Mechanism of the (M. J. S. Dewar), 784
3 : 4-Benzpyrene from Coal Tar (Dr. I Berenblum), 601
Beryllium . Atomic Weight of (Johannsen), 179
Bessel Functions . A Treatise on the Theory of (Prof. G. N. Watson), second edition, *review* by Prof L. M. Milne-Thomson, 190
Bibliography on British Industry and Commerce (Sheffield City Libraries), 44
Biochemical Research Foundation of the Franklin Institute . Reports of the, 331
Biochemistry . Advances in Enzymology and related Subjects of (edited by F. F Nord and C. H. Werkman), Vols 4 and 5, *review* by Dr. J. H. Quastel, 611
Biochemistry of Mental Disorder (Psychiatry section of the Royal Society of Medicine meeting on), 101
Biological Abstracts . Establishment of Section H for Abstracts of Human Biology, 714
Biological Control of Insect and Plant Pests (Dr. W R. Thompson), 271
Biological Fibres and the Problem of Muscle : Structure of (Dr. W. T Astbury), 89
Biological Publications · Belgian, during the War, 166
Biological Work in Finland : Recent (Dr. G. H. Beale), 357
Biology . Reactions at Interfaces and their Significance in (Dr. J. F. Danielli), 468
  Evolutionary, and related Subjects in the U.S.S.R. (Dr. Julian Huxley), 254 ; *errata*, 293
  (Human) . Abstracting Service for, 714
  Middle East Field, 532
  Self-sufficient, *review* by Dr. C. H. Waddington, 731
Biology, Chemistry and Physics in India : Research Fellowships in, 107
Biology and Medicine · Direct Chemical Action upon Nerve Centres in (Prof. Lena Stern), 7
Bionomics of *Hylemyia cinerella* Fallen (Dr. M. Hafez), 48
Birds : Detection of, by Radar (David Lack and G. C. Varley), 446 ; (Lieut. H. A C. McKay), 629
  The Edibility of (Dr. Hugh B. Cott), 736
  (Bower) : Display and Bower Building in (E. Nubling), 168
  Garden (Phyllis Barclay-Smith), *review*, 34
Birds of California : The Distribution of the (Joseph Grinnell and Alden H. Miller), *review*, 34
Birth of a Bat · Unusual State at (T S. Jones), 365
Black Widow, America's Most Poisonous Spider (Raymond W. Thorp and Weldon D. Woodson), *review* by T. H. Savory, 253
Blackbird . The (A F. C. Hillstead), *review* by Sir D'Arcy Thompson, 318
Black-Body Intensity : Departure of Long-Wave Solar Radiation from (Sir Edward Appleton), 534
Blackwell Prize awarded to Dr. Archibald Clow, 45
Blind: Sensory Devices for the (Committee set up by the Council of St. Dunstan's), 200
Blind Seed Disease of Rye-grass (Malcolm Wilson, Mary Noble and Elizabeth G Gray), 178
Blood in Children . Atlas of the (Dr. Kenneth D. Blackfan and Dr. Louis K. Diamond), *review* by Prof. Thos. B. Davie, 192
Blood (Normal) . Crystalline Hæmolytic Substance from (Dr. H. Laser and Dr. E. Friedmann), 507
Blood Pressure and Blood Flow . Influence of, on the Activity of the Respiratory, Vasomotor and Cardio-Regulatory Centres (Prof. C. Heymans), 750
Blood Transfusion : *Rh* and, 625
Blood-sucking Parasites : Hæmoglobin in (Prof H. Munro Fox), 475
Boll Rot of the Cotton Plant (Internal), caused by Insect Punctures (*Dysdercus* sp.), through Selection of Resistant Strains : Control of (Prof. Teodoro Boza Barducci, Prof. Germán García Ráda and Prof. Johannes Wille), 235
Bone : Recent Investigations on the Growth of (Prof. P. Lacroix), 576

ooks : Recent Scientific and Technical, Supp. ii, July 28 ; Supp. ii, August 25 , Supp. ii, September 29 ; Supp. ii, October 27 ; Supp. ii, November 24 ; Supp. ii, December 29
Books and Journals for Holland and Denmark, 263
Borax and 'B_2O_3 Glass Systems : X-Ray Study of the Solution of Alkali Halides in (S. K Majumdar, B K. Banerjee and K. Banerjee), 423
B_2O_3 Glass Systems (Borax and) : X-Ray Study of the Solution of Alkali Halides in (S. K. Majumdar, B. K Banerjee and K. Banerjee), 423
Boron Phosphate in Fireside Deposit from an Economizer · Occurrence of (L. M. Clark and J. Haslam), 302
Botanist for India at Kew, 444
Botany in Latin America, *review*, 676
Bower Birds : Display and Bower Building in (E Nubling), 168
Boys (Charles Vernon) Prize of the Physical Society awarded to Dr. A. H. S. Holbourn, 685
Bread in Jersey during German Occupation (Dr. D W. Kent-Jones and Dr. A. J. Amos), 336
'Bridge' for Two-Solution Cells : A Convenient (Dr. S. M Neale), 506
Bristol : Aeronautical Engineering at, 43
Britain : Chinese Visitors to, 201
  Use of Fertilizers in, 776
  Food Policy in, 292
  National Maps of (Ministry of Town and Country Planning), 776
  Reform of the Patent Law in (Prof. Michael Polanyi), 54 ; (The Writer of the Article), 54
  Research in, on Atomic Energy, 531
  Government Support for Research Associations in (Herbert Morrison), 597
  A State Scientific Service in, 643
  Higher Technological Education in, 699
  Timber Resources of, *review* by Major T. H. Hawkins, 613
  See also under Great Britain
British Achievement in the Art of Healing (John Langdon-Davies), *review* by Dr G. Lapage, 350
British Agricultural Attaché at Washington and Agricultural Adviser at Ottawa : Appointment of A. N. Duckham as, 138
British Anti-Lewisite (*BAL*) (Prof. R. A. Peters, Dr. L. A. Stocken and Dr. R. H. S. Thompson), 616
British Army Veterinary Services in the Far East (Dr. G Lapage), 60
British Colonies : Research and Development in the, 509
  Scientific Research in India and the, 758
British Commonwealth : Research within the (Society of Visiting Scientists meetings to discuss the organisation of), 660
British Cotton Industry Research Association Fellowships, 200, 686
British Electrical Engineers and the War (Dr P. Dunsheath), 482
British Freshwater Nemertine (Rachel R. Braithwaite and Evelyn B. Clayton), 237
British Industry and Commerce : Select Bibliography on (Sheffield City Libraries), 44
British Isles : Map of, 16
British Medical Exhibition at the Sao Jose Hospital in Lisbon, 45
British Moths · Some (Norman Riley), *review*, 34
British Museums during the War Years, 26
British Pig-Raising Industry (Dr. J. E. Nichols), 454
British Radio Industry in War and Peace, 713
British Universities, 263
British Work on Nutrition : Some (Dr. G. Lapage), 123
Brittle Rupture : Mechanism of (J. B. Murgatroyd and R. F. Sykes), 716
Broadcasting (European) : Wave-lengths for, 250
Brown (senior Hume) Prize in Scottish History awarded jointly to Dr. Archibald Clow and Mrs. Nan L. Clow, 45
Bulletin of International News . To be replaced by *The World To-day*, 167
Burns by Hot Gases (Skin) . Production of (O. M. Lidwell), 298
Business : University Education and, 671
Business Production and Administration . Quality Control in (William B. Rice), 330

CABLES (Low-Voltage) : Localization of Faults in (J. H. Savage), 201
Calcium Silicate and Sodium Fluoride Formation of an Addition Compound of (Cyril Brosset), 451
Calculation of Electrical Transients : The Simple (G. W. Carter), *review* by Dr. L. E. C. Hughes, 6
Calculus Operational, *review* by Dr. L. E. C. Hughes, 6
Calculus Made Easy : Heaviside's Operational (Dr. T. H. Turney), *review* by Dr. L. E. C. Hughes, 6
California : The Distribution of the Birds of (Joseph Grinnell and Alden H. Miller), *review*, 34
  Frequency of Earthquakes in (B. Gutenberg and C. F. Richter), 371
California (off Northern) : Earthquake on May 19, 545
Californian Marine Algæ and Grasses, 533
Callendar Steam Tables : The 1939 (G. S. Callendar and Sir Alfred Egerton), second edition, *review* by Dr. H. Heywood, 462
Callianassidæ of the Central Pacific (Charles Howard Edmondson), 395
Calomel and Onion Eelworm (Dr. T. Goodey), 393
Cambridge : Imperial Chemical Industries Fellowships at, 17
  Summer School in X-Ray Crystallography at, 566
Cambridge Men Some, *review* by Prof. F. J. M. Stratton, 348
Canada Post-War Planning for Scientific Research in (Dr. C. J. McKenzie), 500
Canadian Awards for Postgraduate Training, 201
Cancer : Mammary, in Mice (Dr. E. Boyland), 787
Cancer Therapy : National Cancer Institute to compile and publish all data relative to, 387
Canes : Supernova in (M. L. Humason), 777
Cantabrigienses · Alumni (compiled by Dr. J. A. Venn), Part 2, From 1752 to 1900, Vol. 2, Chalmers—Fytche, *review* by Prof. F. J. M. Stratton, 348
Capacitors (Paper) : Chemically Stabilized (D. A. McLean), 455
Carbohydrate Breakdown and Hydration of Enzyme Protein : Cell Proliferation, (Dr. A. Lasnitzki), 398
Carbon : Energy of the Hg—C Bond and the Heat of Atomization of (Prof. N. V. Sidgwick and H. D. Springall), 599
Carbon Dioxide in Fruit Storage and Transport : Use of (F. Gerhardt, E. Smith and H. English), 178 ; (A. V. Doreen, M. B. Hoffman and R. M Smock), 178 , (F. W Allen, W. T. Pentzer and C. O. Bratley), 178 ; (W. T. Pentzer and F. W. Allen), 178
Carbon Dioxide Tension : Rate of Entrance of Ammonia into Muscle Fibres in relation to (Prof E. J. Conway and P. T Moore), 270
Carbon-Monoxide Reactions . Friedel-Crafts Catalysts in (Dr. P. H Sykes), 638
Carbonic Acid : Carboxylase and (Prof. Edward J. Conway and Eithne MacDonnell), 752
Carboxylase and Carbonic Acid (Prof Edward J. Conway and Eithne MacDonnell), 752
Carboxylic Acids (Normal Chain) : Phase Transitions in Condensed Monolayers of (Stina Ställberg-Stenhagen and Einar Stenhagen), 239
Carcinoma in the Fowl : An Induced (F. Bielschowsky and Prof. H. N. Green), 780
Cardio-Regulatory Centres (Respiratory, Vasomotor and) : Influence of Blood Pressure and Blood Flow on the Activity of the (Prof. C. Heymans), 750
Carence en Belgique pendant l'occupation Allemande 1940–1944 : Les états de (Lucien Brull, G. Barac, T Brakier-Zelkowiecz, P Clemens, R Crismer, J. Deltombe, A. Divry, L. Dubois, L. Dumont, L. Dumont-Ruyters, A. Lambrechts, R. Neuprez, A Nizet, M.-J Op de Beeck, J. Piersotte et A Thomas), *review* by Major J Marshall, 551
Carnegie Scientific Results of Cruise VII of the ; Oceanography IA, Observations and Results in Physical Oceanography (H. U. Sverdrup, F M Soule, J. A Fleming and C. C Ennis), 341 ; Chemistry I, Chemical Results (Herbert W. Graham and Erik G. Moberg), 341
β-Carotene in Dried Grass : Determination of (T Barton Mann and W. M Seaber), 571
Carotene from Oils : Influence of Vitamin E on the Utilization of (S. Dattatreya Rao), 449
  Utilization of (S Dattatreya Rao), 234
Carty (fifth John J.) Medal and Award of the United States National Academy of Sciences awarded to William Frederic Durand, 575
Casein : Separation of (R. C. Warner), 179
Catalysts for the Fischer-Tropsch Synthesis · Chromium Oxide as a Promoter in (Sir J. C Ghosh and S. L. Sastry), 506
Catalysts and Polymerization · Friedel-Crafts (Department of Chemistry, University of Manchester conference on), 232
Catalytic Halides (Dr. F. Fairbrother), 638
  The Molecular Structure of the (Dr. H. A. Skinner), 638
Cation and Anion Permeability Constants for the Muscle Fibre Membrane (Prof. E. J. Conway and P. T. Moore), 170
Cattle : Use of Trees and Shrubs as Food for, 151
Cause and Sensation in Philosophy, *review* by Prof. A. D. Ritchie, 33
Cell Contents of Pus (Dr. F. Duran-Jorda), 110
Cell Proliferation, Carbohydrate Breakdown, and Hydration of Enzyme Protein (Dr. A. Lasnitzki), 398
Cells (Animal) : Demonstration of Mitosis in (Dr. W. S. Bullough), 574
Cells (Living) : The Active and Passive Exchanges of Inorganic Ions through the Surfaces of, and through Living Membranes Generally (Prof. August Krogh), 542
Centipede *Lithobius forficatus* (Common) : Behaviour of the (Capt. J. L. Cloudesley-Thompson), 537
Ceratien : Die Bevolkerung des sudatlantischen Ozeans mit (N. Peters), 181
Ceratien im sudlichen Stillen Ozean : Untersuchungen uber die Verbreitung, Biologie and Variation der (E. S. Nielsen), 181
Ceratium in the Pacific and North Atlantic Oceans The Genus (H. W. Graham and N. Bronikovsky), 181
Ceratium and Marine Hydrography (Prof F E. Fritsch), 181
Cereal Diseases (W. C. Moore), 533
Cereals : Weed Control in (Ministry of Agriculture Advisory Leaflet No 315), 330
Cereals and other Plant Species Effect of some Arylcarbamic Esters and related Compounds upon (Dr. W G. Templeman and Dr. W. A. Sexton), 630
Cervico-Facial Pigmentation (Melanosis of Riehl-Poikiloderma) (Dr. Georges Garnier), translated by Major James Marshall, 163
Chalk-washing of Sugar-Beet in Dry Climates (Kolossov), 304
Channels (Very Narrow) Flow of Water through, and Attempts to Measure Thermomechanical Effects in Water (Dr. J. Reekie and J. Aird), 367
Characteristics (Acquired) · Inheritance and (Prof. Wm. Rowan), 236
Chemical Action : Direct, upon Nerve Centres in Biology and Medicine (Prof. Lena Stern), 7
Chemical Analysis and Structural Diagnosis by Infra-red Absorption, *review* by Dr. H. W. Thompson, 65
Chemical and other Processes . Instruments for the Automatic Controlling and Recording of (Institution of Chemical Engineers, the Institute of Physics, and the Chemical Engineering Group of the Society of Chemical Industry joint conference on), 45, 723
Chemical Composition of Marine Organisms (S. I. Tomkeieff), 607
Chemical Engineering at the University of Leeds, 659
Chemical Notation : A Simplified (Sir D'Arcy W. Thompson), 715
Chemical Reactions Energy Transfer in (Prof. M. G. Evans), 639
Chemical Research at Leeds, 659
Chemical Research in the U.S S.R : Recent, 697
Chemical Results of the last Cruise of the *Carnegie* (Herbert W. Graham and Erik G. Moberg), 341
Chemically Stabilized Paper Capacitors (D A. McLean), 455
Chemistry : Oxidation and Reduction in (Prof. J. Kenner), 369
  The Royal College of (Dr E. Frankland Armstrong), 524
  (Analytical) . The Teaching of, in Great Britain, with special reference to Microchemistry (Dr. Cecil L. Wilson), 588
  (Applied) . Annual Reports on the Progress of, Vol. 28, 1943 (Society of Chemical Industry), *review*, 281
  Organic (Louis F. Fieser and Mary Fieser), *review* by Prof. John Read, 96
  (Organic) : The New (Dr. D. H Hey), 36
  Organic, at the Royal Technical College, Glasgow, 685
  (Pharmaceutical) : Origin and Development of (H. Brindle), 138
  Physical, in the U S.S.R. (Prof. C. N. Hinshelwood), 283
  Surface, in the U.S S.R. (Prof. N. K. Adam), 284
Chemistry in China, 511
Chemistry of Natural Colouring Matters (Dr. Fritz Mayer), translated and revised by Dr. A. H. Cook, *review* by Prof. W. Baker, 552

Chemistry of Penicillin (Committee on Medical Research, Washington, and the Medical Research Council, London), 766
Chemistry and Technology of Food and Food Products (edited by Dr. Morris B Jacobs), Vol 2, *review* by Dr T Moran, 220
Chemistry, Physics and Biology in India : Research Fellowships in, 107
Chemists : Social Security for (British Association for Chemists, London Section, open meeting on), 331
Chemotherapy of Tuberculosis (Dr. M. A. Soltys), 210
Child : A Fatal Case of D.D T. Poisoning in a (Major K. R Hill and G. Robinson), 780
Child Guidance . An Introduction to (W Mary Burbury, Edna M. Balint and Bridget J. Yapp), *review* by Dr. Alan Maberly, 157
Child's Blood in Health and Disease, *review* by Prof Thos. B. Davie, 192
Children : Atlas of the Blood in (Dr. Kenneth D. Blackfan and Dr. Louis K. Diamond), *review* by Prof. Thos. B. Davie, 192
  (Young) . Intelligence Tests for (Prof. C. W. Valentine), *review* by Dr. John Cohen, 349
China : Chemistry in, 511
Chinese Visitors to Britain, 201
Chinese Water-chestnut, *Eleocharis tuberosa* : An Antibiotic Substance in the (S L. Chen, B. L Cheng, W. K Cheng and P S. Tang), 234
Cholera, Dysentery and *B coli* (Typhoid,) : Anti-bacterial Action of 'Polyporin' against (Prof S. R. Bose), 171
Choline Esterases (Dr. K-B Augustinsson), 303
Chondrosamine : A Constitutional Synthesis of (Dr. Sybil P James, Dr F. Smith, Dr M. Stacey and Dr. L. F. Wiggins), 308
Chree (Charles) Medal and Prize of the Physical Society awarded to Dr. John A. Fleming, 658
Chromatographic Measurements : Adsorption Isotherms from (Dr E. Gluckauf), 748
Chromatography of Two Solutes (Dr. E. Gluckauf), 205, 571 ; (A C Offord and Dr. J Weiss), 570
Chromatophore Reactions . Pigments and, of *Polycelis nigra* and *Planaria lugubris* (Capt. J L. Cloudsley-Thompson), 294
Chromium, Cobalt and Nickel in Eruptive Rocks (Vanadium,) : Distribution of (Prof. L. R. Wager and R L. Mitchell), 207
Chromium Oxide as a Promoter in Catalysts for the Fischer-Tropsch Synthesis (Sir J C. Ghosh and S L. Sastry), 506
Chromosomes : Human (Prof. M. E Varela), 755
  Phosphatase on (Dr. J F. Danielli and D. G Catcheside), 294
Civil Service : The Scientific, 643
Classification of Recent Philosophy, *review* by Prof A. D. Ritchie, 376
Classification and Nomenclature of Animal Behaviour (Dr J. S. Kennedy), 754
Clever : The Good and the (Master of Balliol), 744
Climates (Dry) : Chalk-washing of Sugar-Beet in (Kolossov), 304
Climatology (Prof. Bernhard Haurwitz and Prof. James M. Austin), *review* by Prof D Brunt, 157
  Methods in (Victor Conrad), *review*, 317
Clines : Progressive (F. W. Braestrup), 337
Clingfishes . American (L. P. Schultz), 304
Clinical Technique : Interpretation of Fantasy as a, *review* by Dr. John Cohen, 701
Clock-Regraduations and Relativistic Cosmology (Dr. T J. Willmore), 748
Closure and Partial Separation of a Metallic Contact (Dr. Alan Fairweather), 545
Clover Nodule Formation associated with the Volume of the Medium Occupied by the Roots A Factor in (Dr. P. S. Nutman), 20
Coagulation : Heat, of Muscle Proteins (Dr. E. C. Bate-Smith and J. R. Bendall), 632
Coal Gas Flames : Influence of Sulphur Oxides on the Luminosity of (Dr. G. Whittingham), 207
Coal Tar : 3 : 4-Benzpyrene from (Dr I. Berenblum), 601
Coals Infra-Red Spectra of (C. G. Cannon and Dr. G. B. B. M. Sutherland), 240
Co$_2$-Al$_5$. Unit Cell and Space-Group of (Audrey M. B. Parker), 783
Cobalt and Nickel in Eruptive Rocks (Vanadium, Chromium,) : Distribution of (Prof. L. R Wager and R L. Mitchell), 207
Coco-nut : Nutritive Value of (Dr. J. M Vanderbelt), 174
Cod (*Gadus callarius* L.) in the Newfoundland Area including Labrador : A Biological and Economic Study of the (Dr Harold Thompson), 213
Coefficients (Termination) . Propagation and, for Vinyl Acetate Photo-polymerization (G. M Burnett and Prof H. W. Melville), 661
Cohesion : Degree of Association of Water from the Energy of Viscosity and the Work of (L. Grunberg and Dr. A. G. Nissan), 335
Col du Lautaret, Hautes-Alpes . Cosmic Radiation observed at the (Jean Daudin), 420
Collaboration . International, 78
Colloidal Solutions : Viscosity of Liquids and (Academy of Sciences of the U S S.R conference on), 147
Colombia (off) : Earthquake on March 17, 264
Colonial Geological Survey : The Contribution of, to the Development of the Mineral and other Resources of East and West Africa (Sir Edmund Teale), 167
Colonial Research 1944–45, 509
Colonial Universities and their Functions, 345, 373
Colonies : Report of the Commission on Higher Education in the, 345
  Report of the West Indies Committee of the Commission on Higher Education in the, 345
  (British) : Research and Development in the, 509
  (British) : Scientific Research in India and the, 758
Colorado Beetle in England during the War, 776
Colorimetric Analysis (Noel L Allport), *review* by A. L. Bacharach, 434
Colour Reaction in Yeast (Mignon Malm), 52
Colour Sensitivity of the Fovea Centralis (E. N. Willmer and W. D. Wright), 119,
Colour Vision Darkened Violet in (Dr. R. W. Pickford), 506
  Electrotonus in (Prof S V. Kravkov and L P. Galotchkina), *erratum*, 626
Colouring Matters (Natural) : The Chemistry of (Dr. Fritz Mayer), translated and revised by Dr. A H. Cook, *review* by Prof. W. Baker, 552
Comets ? . What are (Enrique Gaviola), 79
Commonwealth (British) : Research within the (Society for Visiting Scientists meetings to discuss the organisation of), 660
Community : Museums and the, 165
  Universities and the Needs of the, 183
Compasses : Repeating (W. E. May), 593
Complex Variable : Functions of a, *review* by J. H. Pearce, 67
Compregnated Wood (D. Narayanamurti and Kartar Singh), 787
Compromise and Integration (Colonel L. Urwick), 93
Concept of Mental Maturity (Prof. A. W. Wolters), 494
Conditioned Excitors and Human Sense Organs (Prof Krikor Kekcheyev), 573
Conditioned Reflexes : Research in the U.S S.R. on, 455
Conditioning of Plywood, 139
Conductors (Steel-Cored Aluminium) : Tensile Load on (E W. W Double), 305
Congo Red Fibrin Powder for Experiments on Proteolytic Enzymes (D G. Duncan and Dr. H. Zwarenstein), 112
Coniques : Les (Prof. Henri Lebesgue), *review* by Prof. H. T. H. Piaggio, 648
Contact (Metallic) : Closure and Partial Separation of a (Dr. Alan Fairweather), 545
Continuity and Discontinuity (Prof. J. K. Robertson), 271
Control of Germany and Japan (Dr. Harold G. Moulton and Dr. Louis Marlio), 64
Control and Recording : Automatic, in Chemical and other Processes (Institution of Chemical Engineers, the Institute of Physics, and the Chemical Engineering Group of the Society of Chemical Industry conference on), 45, 723
Controlled Projection (1944) (arranged by John C. Raven), *review* by Dr. John Cohen, 701
Cook Islands . Arts and Crafts of the (Mrs. K. Rishbeth), 61
Co-operation International, in Social and Economic Fields, 231
Co-ordinates (Atomic) : Accuracy of, Derived from Fourier Systems (A D Booth), 51
Copley Medal of the Royal Society awarded to Dr. O T. Avery, 596, 694
Corona (Solar) : A Physical Theory of the (Dr. A. Hunter), 649
Corpuscles of the Hen (Red) : Life-Cycle of the (Prof G. Hevesy and J. Ottesen), 534
Correlation (Multiple) : Estimation of, by means of Stereographic Projection (G F. K. Naylor), 58
Corrosion of Metallic Couples : Hydrogen Overvoltage as a Factor in the (L F LeBrocq and H. C. Cocks), 536
Corrosion of Metals (Institute of Physics, London and Home Counties' Branch, discussion on), 435
Cosmic Radiation (Dr L. Jánossy), 704
Cosmic Radiation observed at the Col du Lautaret, Hautes-Alpes (Jean Daudin), 420
Cosmic Rays : Anglo-French Conference on, 140, 543
Cosmic Rays and Kinematical Relativity (Prof. J B. S. Haldane), 266 ; (Prof. Herbert Dingle), 389
'Cosmic Static' (Grote Reber), 396
Cosmogony of the Solar System : A New (Dr. A. Hunter), 378
Cosmology (Relativistic) : A New Approach to (Prof. L Infeld), 114
  Clock-Regraduations and (Dr. T J Willmore), 748
Cottid Fishes : Marine, of California (Rolf L. Bolin), 395
Cotton Plant : Control of Internal Boll Rot of the, caused by Insect Punctures (*Dysdercus* sp.), through Selection of Resistant Strains (Prof. Teodoro Boza Barducci, Prof. Germán García Ráda and Prof. Johannes Wille), 235
Cracking (Exposure) : The Mechanism of (Dr R G Newton), 10
Cracking (Rubber) : The Mechanism of (E F. Powell and V. E. Gough), 11
Crafts of the Cook Islands : Arts and (Mrs. K. Rishbeth), 61
Crater Fumaroles of Kibo and Seismic Activity during 1942–45 (J J. Richard), 352
Croonian Lecture of the Royal Society (Dr. W. T Astbury), 89 , (Prof. August Krogh), 542
Crystalline Aggregates : High Permittivity (Prof Willis Jackson and W. Reddish), 717
Crystalline Hæmolytic Substance from Normal Blood (Dr H. Laser and Dr. E. Friedmann), 507
Crystallization and Identity of the Triose and Triosephosphate Dehydrogenases of Muscle (Ranwel Caputto and Dr. Malcolm Dixon), 630
Crystallography in the U.S S R. (Dr. W. A Wooster), 256
Crystals : Some Problems of the Theory of (Prof Max Born), 705
  (Single Metal) . Effect of Alpha-Ray Bombardment on Glide in (Prof. E N. da C. Andrade), 113
Crystal Plates (Non-Piezo-Electric) : Shear Modes in (Prof. S. Bhagavantam and J Bhimasenachar), 23
Crystal Structure of Barium Titanate (W. F. Forrester and R, M. Hinde), 177
Crystal Structure of Diamond (G. N Ramachandran), 83
Culex (*Barraudius*) *modestus* Ficalbi (Diptera, Culicidæ) obtained in the South of England : Records of (John F Marshall), 172
Cultural Organisation of the United Nations (Educational and) : Draft proposals for an, 263 ; (Prof. Norman Bentwich), 445
Cultural Organisation (Educational and) : A United Nations—Introduction (Dr. E F Armstrong), 553 ; Science and the United Nations (Dr. Julian Huxley), 553 ; World Co-operation in Science (J. G. Crowther), 556 ; A Permanent International Scientific Commission (Prof. J D Bernal), 557 ; The Place of Science and International Scientific Co-operation in Post-War World Organisation, 558
  Scientific Delegates to the, 565
Culture : A Scientific Theory of, and other Essays (Bronislaw Malinowski), *review* by Dr. C S Myers, 218
Cytological Reactions Induced by Inorganic Salt Solutions (Albert Levan), 751
Czech Botanists during the War, 416
Czechoslovakia Scientific Co-operation with, 416

DANISH Research Expedition, 565
Danube Basin and the German Economic Sphere (Dr. Antonin Basch), *review* by Capt. Maurice Bruce, 551
Darkened Violet in Colour Vision (Dr. R W Pickford), 506
Darwin (Charles) memorial rooms at Down House . Re-opening of the, 533
Data for Identification Purposes : Indexes of (Dr. A F Wells), 535
Davy Medal of the Royal Society awarded to Prof. Roger Adams, 596, 695

aylight Rays (Ultra-Violet and) : Behaviour of, in the Solar Cycle (Dr. J R. Ashworth), 115
D.T. · Control by, of Flies Breeding in Percolating Sewage Filters (T. G. Tomlinson), 478
  Insecticidal Action of (J R. Busvine), 169
  Phytopathological Uses of the new Insecticide, (H. Martin and R. L. Wain), 168
  Toxicity of, to the Housefly (E. A Parkin and A A Green), 745
.D T. in Soap : Efficacy of (G A. Campbell, F. C Hymas and Dr. T. F. West), 749
D T Poisoning in a Child : A Fatal Case of (Major K. R. Hill and G. Robinson), 780
ean (Bashford) Memorial Volume on Archaic Fishes : Completion of the (Dr. E. W Gudger), 533
ecca Navigator System, 542
efence (National) : Science and, 29, 63, 457
eficiency Diseases in Belgium, *review* by Major J. Marshall, 551
egeneration and Repair of Nerve Fibres : Structure, (J. Z. Young), 132
egradation Products : Primary, of Mepacrine in Human Urines (D Ll. Hammick and S. F. Mason), 718
ehydrogenases of Muscle (Triose and Triosephosphate) : Crystallization and Identity of the (Ranwel Caputto and Dr. Malcolm Dixon), 630
Demobilization, Rehabilitation and Land Use, 429
Denmark (Holland and) : Books and Journals for, 263
Density in Solutions (Interfacial Tension and) : Time Dependence of (Prof. George Antonoff), 301
Dental Teaching and Research in Great Britain Nuffield Foundation to make grants for, 417
Dermatoses : Relation of the Gonadal Hormones to certain (Dr Georges Garnier), translated by Major James Marshall, 339
Desert Locust · Presence of Reddish Pigment in Eggs and Ovarioles of the, and its Probable Phase Significance (Dr. M. L. Roonwal), 19
Desiccation : Losses of Nitrous Nitrogen from Soils on (Dr M. R. Madhok and Fazal-Uddin), 49
Detection of Birds by Radar (David Lack and G. C. Varley), 446 ; (Lieut. H A. C McKay), 629
Development (Research and) : in the British Colonies, 509
  in the United States, 360
Dialkyl Succinic Acid Derivatives : Inhibitory Action of, on the Growth *in vitro* of Acid-fast Bacteria (Vincent C Barry and Dr. P. A. McNally), 48
Diameters of the Living Eye by means of X-Rays : Measurement of the (Prof. Arnold Sorsby and A. D. O'Connor), 779
Diamine Oxidase · Action of Mepacrine on (Dr. H. Blaschko and Ruth Duthie), 113
Diamond : Allotropic Modifications of (Sir C. V Raman), 22
  Crystal Structure of (G. N. Ramachandran), 83
  Infra-Red Spectrum of (K. G Ramanathan), 23
Diatomic Oxides : Spectra of, by the Method of Exploded Wire (B. Rosen), 570
Dibenzyl : Structure of (Dr. G. A. Jeffrey), 82
Dibenzylphosphoryl Chloride for Phosphorylations : Use of (Dr. A. Deutsch and O. Ferno), 604
Dickinson Presentation Fund, 417
Dielectric Constants of some Titanates (Dr. B. Wul), 480
Dielectric Surface (Lichtenberg Figures) : Electric Discharge on a (A. Morris Thomas), 451
Dienoestrol and Stilboestrol Solutions : Instability of (A. E. Wilder Smith and P. C. Williams), 718
Diet : Hospital (Dr. G. Lapage), 725
Diet of Domestic and Non-Domestic Animals : Effect of High Vitamin A in the (Hilda H. Wheeler), 238
Dietitians : The Training, Qualifications and Function of (Nutrition Society conference on), 566
Difference Tones (A. J. King), 536
  Production of (Prof. Frank Allen), 84
Differentiation of Nuclear Substances (Ch. Wunderly), 750
Diffusion Pump : Comparative Vacua Produced by Different Oils in a (Kamalesh Ray and Nanda Dulal Sengupta), 636
Diffusion Pumps : Performance of (Dr. K. C. D. Hickman), 635
Dilthey, Wilhelm—an Introduction (Prof. H. A. Hodges), *review* by Dr. A. D. Lindsay, 461
9 : 10-Dimethyl-1 : 2-Benzanthracene : Spontaneous Regression of Histologically Malignant Tumours Induced in Rabbits by (Stephan Beck), 238
2 : 6-Dimethyl-β-d-Galactopyranose (Crystalline) : The Isolation of, from the Methylated Polysaccharide—A Polysaccharide from *Gigartina stellata* (Eric T. Dewar and Dr. E. G. V. Percival), 633
Diphyllobothriidæ in Ireland : Occurrence of the (J. R. Harris and Dr. M. D. Hickey), 447
Dipropyl Ketone at Low Temperatures : Fluorescence of (Dr. S. C. Sirkar and B. M. Bishui), 333
Directiveness of Organic Activities (Dr. E. S. Russell), *review* by Dr. C. H. Waddington, 731
Discontinuity : Continuity and (Prof. J. K. Robertson), 271
Disease : Contributions of the Imperial College to the Conquest of (Lord Rayleigh), 520
Disease (Human) : Tyroglyphid Mites and (Dr. G. Lapage), 427
Disease (Health and) : The Child's Blood in, *review* by Prof. Thos. B. Davie, 192
Diseases : Cereal (W. C. Moore), 533
  Deficiency, in Belgium, *review* by Major J. Marshall, 551
  The Venereal, 501
Documentary Reproduction : Microfilm and other Means of (Association of Special Libraries and Information Bureaux conference on), 24
Double-Refringence of the Amyloid-Congo-Red-Complex in Histological Sections (Dr. Peter Ladewig), 81
Draper (Henry) Medal of the United States National Academy of Sciences for 1945 awarded to Paul W. Merrill, 575
Drawings (Line) : Lantern Slides of (Dr. G. D. Yarnold and L. Heath), 574
Dry Rot of Seed Potatoes : Control of, by Dusting (Dr. C. E. Foister, Dr. A. R. Wilson and Dr. A. E. W. Boyd), 394
Dublin Colloquium, 1945 (Prof. Max Born), 704
Duddell Medal for 1945 of the Physical Society awarded to Prof. J. T. Randall, 685
Durban . Amoebiasis in (Major R Elsdon-Dew), 118
Dusting : Control of Dry Rot of Seed Potatoes by (Dr. C. E Foister, Dr. A. R Wilson and Dr. A. E. W. Boyd), 394
Dwarf Binaries · White (Dr. W. J. Luyten), 293
Dysentery and *B. coli* (Typhoid, Cholera,) . Anti-bacterial Action of 'Polyporin' against (Prof. S. R. Bose), 171

EARTH : Thermal History of the (Dr. E. C. Bullard), 35
Earth and Planets · A Meteoric Theory of the Origin of the (Dr. O. J. Schmidt), 185
Earth Wire : Surge Characteristics of a Three-Phase Transmission Line with (W. G. Hawley), 305
Earth's Atmospheric Oxygen · Stability of the (Alfred Lauck Parson), 504
Earth's Magnetism (Prof. Sydney Chapman), 45
Earthquake
  in the Arabian Sea on November 27, 712
  off northern California on May 19, 545
  In Chiriqui Province, Panama, on June 3, 545
  off Colombia on March 17, 264
  off the coast of Japan on January 12, 79 ; on February 10, 79
  east of Kamchatka on April 15, 201
  off Mazatlan, Mexico, on April 15, 201
  west of Mexico on May 19, 201
  east of New Zealand on April 19, 201
Earthquakes
  During the First Quarter of 1945, 264
  registered in the Isle of Wight by E. W. Pollard during March, 79 ; during April and May, 201 , during June, 545 ; on November 27, 712
  registered at King's College Observatory, Aberdeen, during the First Quarter of 1945, 264 ; during April, May and June, 545
  registered in New Zealand, during January, 79 ; during February and March, 264 ; during April, 544 , during 1942 and 1943 (R. C. Hayes), 396
  registered in Spain, during January, 79 , during February, 79 ; during March, 264 ; during April, 544
  Recent, 79, 201, 544
  Study of, *review* by E. Tillotson, 95
Earthquakes in California . Frequency of (B. Gutenberg and C. F. Richter), 371
Earthworm : Motor Response from Giant Fibres in the (Dr. W. A. H. Rushton), 109
Ecological Studies (Tropical): Need for Development of (Dr. C. J. Chapman, C. O. Flemmich, A. L. Griffith, J. L. Harley, R. Hobbins, C. H. Holmes, C. de Rosayro and J. Wyatt-Smith), 627
Ecology : Marine, in South Africa, 27
Ecology in the Service of Man, *review* by Sir John Russell, 675
Economic Fields (Social and) : International Co-operation in, 231
Economic and Social Council : The Scientist and the (Guy B. Gresford), 625
Economics of Advertising (F. P. Bishop), *review*, 765
Economizer . Occurrence of Boron Phosphate in Fireside Deposit from an (L. M. Clark and J. Haslam), 302
Economy in Sampling (G. A. Barnard), 208
Edibility of Birds (Dr Hugh B. Cott), 736
Education : The Allied Plan for (Dr. E. F. Armstrong), 708
  Principles of, *review* by T. Raymont, 676
  Science and (Association of Scientific Workers, Leeds Branch, conference on), 56
  Science and, in India, 291
  The Science Film in (Miss Dorothy Grayson), 426
  Sex—Aims, Possibilities and Plans (Cyril Bibby), 412, 438
  (Adult) . Science in (C. V. Bellamy), 57
  Army—Educating the Educators, 513
  The Army School of, Eltham Palace (Major T. H. Hawkins), 527
  Higher, in the Colonies (Report of the Commission on), 345
  Higher, in the Colonies (Report of the West Indies Committee of the Commission on), 345
  Higher, in West Africa (Report of the Commission on), 345
  Higher Technological, in Britain, 699
  (Technical) : Part-time (Dr. P. D. Ritchie), 57
  University, and Business, 671
Education, its Data and First Principles (Sir Percy Nunn), third edition, *review* by T. Raymont, 676
Education in H.M. Forces, 107
Education in International Morality : Problems of (United Nations Fellowship discussion on), 444
Education of the Technologist (Prof. J. B. Speakman), 57
Education and Training of Aircraft Workers, 78
Educational Reconstruction in the United Nations : Post-War (edited by Prof. I. L. Kandel), *review*, 318
Educational and Cultural Organisation of the United Nations (Prof. Norman Bentwich), 445
Educational and Cultural Organisation : A United Nations—Introduction (Dr. E. F. Armstrong), 553 ; Science and the United Nations (Dr. Julian Huxley), 553 ; World Co-operation in Science (J. G. Crowther), 556 ; A Permanent International Scientific Commission (Prof. J. D Bernal), 557 ; The Place of Science and International Scientific Co-operation in Post-War World Organisation, 558
  Scientific Delegates to the, 565
Egg of *Ixodes ricinus* L : Hatching of the (D. R. Arthur), 538
Egg-Yolk Medium : Respiration of Spermatozoa in (J. Tošić and Dr. Arthur Walton), 507
Eggs and Ovarioles of the Desert Locust : Presence of Reddish Pigments in, and its Probable Phase Significance (Dr. M. L. Roonwal), 19
Electric Discharge on a Dielectric Surface (Lichtenberg Figures) (A. Morris Thomas), 451
Electric Transmission : Surge Characteristics in, 305
Electrical Engineers : British, and the War (Dr. P. Dunsheath), 482
Electrical Hypothesis of Synaptic and Neuromuscular Transmission (Prof. J. C. Eccles), 680
Electrical Moisture Meter (Dr. L. Hartshorn and W. Wilson), 16
Electrical Resistance of Liquid Metals (Prof. K. S. Krishnan and A. B. Bhatia), 503

Electrical Transients   The Simple Calculation of (G. W. Carter), *review* by Dr. L. E. C. Hughes, 6
Electricity—Public or Private Monopoly ? (F. Hamlyn Dennis), *review* by C. W. Marshall, 585
Electricity Supply in Matabeleland : Future of (A R. Sibson), 168
Electricity Supply Organisation, *review* by C. W. Marshall, 585
Electricity Supply Systems : Operational Control of (W. Kidd and E M. S McWhirter), 361
Electrocardiography : New Basic Concepts In—The Ventricular Gradient (Dr. W. F. Berg), 590
Electromagnetism and Gravitation : A Classical Theory of (Dr. H. C Corben), 388
Electromechanical Analogies (Dr. A. Bloch), 151
'Electron Radiography' using Secondary β-Radiation from Lead Intensifying Screens (H. S. Tasker and S. W Towers), 50
Electron Shadow-Micrographs of Hæmocyanin Molecules (Prof. Robley C. Williams and Dr. Ralph W. G. Wyckoff), 68
Electron Transfers : Univalent, in Aromatic Nitration ? (G. A Benford, C. A. Bunton, E. S. Halberstadt, Dr. E. D Hughes, Prof. C K Ingold, G J. Minkoff and R. I. Reed), 688
Electronic Phase Velocity . A New Occurrence of the (W E. Benham), 204
Electrotonus in Colour Vision (Prof S V. Kravkov and L. P. Galotchkina), *erratum*, 626
Elements Rage : The (Frank W. Lane), *review* by Prof. D. Brunt, 703
Eleocharis tuberosa : An Antibiotic Substance in the Chinese Water-chestnut, (S. L. Chen, B. L. Cheng, W. K. Cheng and P S. Tang), 234
Elliot (Daniel Giraud) Medal of the United States National Academy of Sciences, for 1941 awarded to Th. Dobzhansky, 575 ; for 1942 awarded to Sir D'Arcy Thompson, 575 ; for 1943 awarded to Karl Spencer Lashley, 575
Elliptische Funktionen . Vorlesungen uber allgemeine Funktionentheorie und (Prof Adolf Hurwitz), dritte auflage, *review* by J. H. Pearce, 67
Embedding Medium : Ester Wax, a New (Dr. H. F Steedman), 121
Embryo . The Early Human, *review* by Dr. C H. Waddington, 375
Embryology . Human (Prof. W. J. Hamilton, Prof. J. D. Boyd and Prof. H. W. Mossman), *review* by Dr D. V. Davies, 315
Embryology of Angiosperms as a Field for Research (Dr. P. Maheshwari), 354
Emission Bands of the Fluctuation Type in the Spectrum of Iodine (Prof R K. Asundi and P. Venkateswarlu), 452
Enamel Cuticle (Nasmyth's Membrane) and Tartar Deposition in the Ferret (Dr. J. D. King), 572
End-Group Determination to Structural Problems in the Polysaccharides : Application of New Methods of (F. Brown, Sonia Dunstan, T. G. Halsall, Prof E. L. Hirst and J. K. N. Jones), 785
Endocrinology . Recent Advances in (Prof. A. T. Cameron), fifth edition, *review*, 34
Endodermal Pellogen in the Stem of *Paederia foetida* Linn. (Dr. P Maheshwari), 116
Energies (Low) : Energy Spectrum of Mesotrons at (S. K. Ghosh and N. N. Das Gupta), 83
Energy : Atomic, 609, 768
  Atomic, an International Responsibility, 153
  (Atomic) : Advisory Committee on, 262
  (Atomic) : Three-Power Declaration on, 615
Energy Generation in the Sun : Nuclear (N. R. Sen and U. R. Burman), 305
Energy Regulators (Sunvic Controls, Ltd.), 167
Energy Spectrum of Mesotrons at Low Energies (S. K. Ghosh and N. N. Das Gupta), 83
Energy Transfer in Chemical Reactions (Prof M. G Evans), 639
Energy of the Hg—C Bond and the Heat of Atomization of Carbon (Prof. N. V. Sidgwick and H. D. Springall), 599
Engineering : Aeronautical, at Bristol, 43
  Chemical, at the University of Leeds, 659
Engineering at the Imperial College : The City and Guilds College—(Prof. E F. D. Witchell), 650
Engineering at Queen Mary College, London, 137
Engineering and Optical Equipment (Precision) . Coventry Gauge and Tool Co., Ltd , Taylor, Taylor and Hobson, Ltd , and E. R. Watts and Son, Ltd., to co-operate in the development and distribution of, 387
Engineering and Science : Research Fellowships in, 659 .
Engineers : British Electrical, and the War (Dr. P. Dunsheath), 482
  Training of (Prof. Andrew Robertson), 775
England : Witchcraft in (Christina Hole), *review*, 765
  (South of) : Records of *Culex* (*Barraudius*) *modestus* (Diptera, Culicidæ) obtained in the (John F. Marshall), 172
England during the War : Colorado Beetle in, 776
England and Wales · Care of Geological Features in, 485
English Plants (Familiar)   A Flora of, *review* by Prof. F. J. Lewis, 461
Entry of Contact Insecticides : Mode of (W H. Potts and F. L. Vanderplank), 112 ; (Dr. N. E. Hickin), 753
Enzyme Activity as a Factor in Insect Physiology and Toxicology (Dr. H. Hurst), 194
Enzyme Protein · | Cell Proliferation, Carbohydrate Breakdown and Hydration of (Dr. A. Lasnitzki), 398
Enzyme System from Ischæmic Muscle : Synthesis of Adenosine Triphosphate by an (Marian Bielschowsky and Prof. H. N. Green), 117
Enzyme and Immune Reactions : Comparison of, *review* by Dr. P. Johnson, 517
Enzymes on Solid Nucleic Acid : Adsorption of (Dr. J. A. V. Butler), 781
Enzymes (Proteolytic) : Congo Red Fibrin Powder for Experiments on (D. G. Duncan and Dr. H. Zwarenstein), 112
Enzymology and related Subjects of Biochemistry : Advances in (edited by F. F. Nord and C. H. Werkman), Vols 4 and 5, *review* by Dr. J. H. Quastel, 611
Eosinophils and Pseudo-eosinophils of Rabbits' Blood : Differentiation between, by means of a Peroxidase Reaction (Dr F. Jacoby), 420
Ephemerides for the Determination of Time Corrections by Equal Altitudes (Zinger's Method) for 1944 (Astronomical Institute of the Academy of Sciences of the U.S S.R.), 16
Equatorial Regions : The Soils of, with special reference to the Netherlands East Indies (Prof. Dr. E. C. Jul. Mohr), translated from the Nederlandsch by Robert L. Pendleton, *review* by Dr. A Muir, 93
Ergot on *Pennisetum Hohenackeri* Hochst. (Prof. M. J. Thirumalachar), 754
Ergot in the Tropical Plains of Bengal : Artificial Production of (J. C. Saha and S. K. Bhattacharjee), 363
Eros . Re-Observation of the Magnitudes of the Southern Compariso Stars for (R. H. Stoy and A Menzies), 179
Escherichia coli : A Thermostabile, Fungistatic Factor from (Sten Wiedling), 204
Ester Wax, a New Embedding Medium (Dr. H. F. Steedman), 121
Ethics · Science and (Prof John A Ryle), 619, 623
Euphorbia Extracts   Insecticidal Properties of (F L Vanderplank), 782
Europe . Germany and (Dr. F. Darmstaedter), *review* by Capt. Maurice Bruce, 551
  Scientific Affairs in, 576
  Scientific Rehabilitation in, 472
  (Central) . Poverty and Politics in, *review* by Capt. Maurice Bruce, 55[illegible]
  (Modern)   The Scapegoat in (Royal Anthropological Institute and the Social Psychology Section of the British Psychological Society discussion on), 380
European Agriculture (United Nations Relief and Rehabilitation Administration), 15
European Broadcasting : Wave-lengths for, 250
Evolution . Animal Learning and (Dr. W H Thorpe), 46
  Tempo and Mode in (George Gaylord Simpson), *review* by Dr. Julian S Huxley, 3
Evolutionary Biology and related Subjects in the U.S S R. (Dr. Julian Huxley), 254 ; *errata*, 293
Evolutionary Change (Major) : Genetics and, *review* by Dr Julian S. Huxley, 3
Excavations at Hyrax Hill, Nakuru, Kenya Colony, 1937–1938 : Report on the (Mary D. Leakey), 722
Exchanges of Inorganic Ions through the Surfaces of Living Cells and through Living Membranes Generally . The Active and Passive (Prof August Krogh), 542
Excitors : Conditioned, and Human Sense Organs (Prof. Krikor Kekcheyev), 573
Experience of Time and its Lapse Rate : The Fitzgerald Contraction as the Origin of our (Prof. W. Peddie), 336
Exploded Wire : Spectra of Diatomic Oxides by the Method of (B. Rosen), 570
Exploration : Archæological, in South Africa (Prof. D M. S. Watson), 55
Explosives . The Science of (Prof Martin Meyer), *review* by Prof. John Read, 5
Exposure Cracking · The Mechanism of (Dr R. G. Newton), 10
Eye : A Pathology of the (Eugene Wolff), second edition, *review*, 279
  (Dark-adapting) · Absolute and Differential Light Sensitivity of the (Dr. H. Pollak and D. G. Wilson), 299
  (Living) : Measurement of the Diameters of the, by means of X-Rays (Prof Arnold Sorsby and A. D. O'Connor), 779

FAITHS of Many Lands (E. Royston Pike), *review* by Enid Blyton, 34
Familial Susceptibility to Tuberculosis (Dr. Ruth Rice Puffer), *review*, 19[illegible]
Family : The Needs and Problems of the (British Social Hygiene Council and the Town and Country Planning Association conference on), 777
Family Food Consumption in the United States (Miss M W Grant), 441
Fantasy as a Clinical Technique   Interpretation of, *review* by Dr. John Cohen, 701
Far East : Air Photography in the (Dr. V. J. Chapman), 604
  British Army Veterinary Services in the (Dr. G. Lapage), 60
Farm Accounting . Good (A. C. Campbell), *review*, 764
Farm Animals : Physiology of (Dr. F. H. A Marshall and E. T. Halnan), third edition, *review* by Dr. John Hammond, 377
Farmer (Woman) · Experiences of a, *review* by Sir John Russell, 280
Farmers · Accounting for, *review*, 764
Fatty Acids : Lubrication of Metal Surfaces by (Dr. F. P. Bowden, J. N. Gregory and Dr. D Tabor), 97
Fatty Constituents of Tubercle Bacilli as Growth-Inhibitors of the same Bacilli (Dr. Ng. Ph. Buu-Hoï), 392
Faulenseemoos bei Spiez : Pollenanalytische, stratigraphische und geochronologische Untersuchungen aus dem (Max Welton), 383
Faults in Low-Voltage Cables : Localization of (J. H. Savage), 201
Fauna and Flora of South Africa (Intertidal) . The Constitution of the (Prof. T. A. Stephenson), Part 2, 27
Fellmongering : Scientific Study of (Dr. D. Jordan Lloyd), 483
Fellowships · British Cotton Industry Research Association, 200, 686
Fellowships for Scientific Research in India, 107
Fermentation and Human Nutrition (Dr. B. S. Platt), 87
Fermented Foods (African) : B Vitamins in (Dr. Leon Golberg, J. M. Thorp and Sheila Sussman), 364
Ferns . An Experimental Treatment of the Apical Meristem in (Prof. C. W. Wardlaw), 39
Ferret . Enamel Cuticle (Nasmyth's Membrane) and Tartar Deposition in the (Dr. J. D. King), 572
Ferrier Lecture (Dr. Gordon Holmes), 201
Fertilizers in Britain : Use of, 776
Fertilizers during the War and After (Dr. E M Crowther), 776
Feulgen Reaction : Mechanism of the (J. G. Carr), 143
Fibres (Biological) . Structure of, and the Problem of Muscle (Dr W . T. Astbury), 89
Fibres (Nerve) . Structure, Degeneration and Repair of (J. Z. Young), 132
Fibres (Wool) · Frictional Properties of (M. Lipson), 268
  Scaliness of (J. Menkart and Prof. J. B Speakman), 143
Fibrin : Transition of Fibrinogen to, as a Two-Step Reaction (Dr. K. Laki and Dr. W. F. H. M. Mommaerts), 664
Fibrin Powder . Congo Red, for Experiments on Proteolytic Enzymes (D. G. Duncan and Dr H. Zwarenstein), 112
Fibrinogen to Fibrin as a Two-Step Reaction · Transition of (Dr. K. Laki and Dr. W. F. H. M. Mommaerts), 664
Field Biology . Middle East, 532
Film as an Instrument of Scientific Research (Derek Stewart), 426
Film in Science (Scientific Film Association conference on), 79, 426
Film (Scientific) : Teaching by means of the (J. Maddison), 57
Film Production (Basil Wright), 426
Film Strip in Technical Training (H. Richmond), 426

Film-Strip Projector : A New (Dufay-Chromex, Ltd.), 264
Films (Thin Metallic) : Resistivity of (Prof. A. Van Itterbeek and L. De Greve), 634
Filters (Percolating Sewage) : Control by D.D T. of Flies Breeding in (T. G. Tomlinson), 478
Finland . Recent Biological Work in (Dr G. H. Beale), 357
Fireside Deposit from an Economizer : Occurrence of Boron Phosphate in (L. M. Clark and J. Haslam), 302
Fischer-Tropsch Synthesis : Chromium Oxide as a Promoter in Catalysts for the (Sir J. C. Ghosh and S. L. Sastry), 506
Fish after a Major Injury : Survival of a, 714
Fish from New Jersey (Apogonid) · Description of a New Genus and Species of (Henry B. Fowler), 395
Fishes : Marine Cottid, of California (Rolf L. Bolin), 395
  New Genera and Species of, 395
  (Archaic) : Completion of the Bashford Dean Memorial Volume on (Dr. E. W. Gudger), 533
Fishes and Fisheries : Indian (Dr. Sunder Lal Hora), 511
'Fissibactericidal' Nature of Penicillin Action (Dr. S. W. Lee, E J. Foley and E. R. Caley), 49
Fitzgerald Contraction as the Origin of our Experience of Time and its Lapse Rate (Prof. W. Peddie), 336
Flagellates . Autotrophic, as the Major Constituents of the Oceanic Phytoplankton (Dr. W. R. G Atkins), 446
Flames (Coal Gas) : Influence of Sulphur Oxides on the Luminosity of (Dr. G. Whittingham), 207
Flavelle Medal of the Royal Society of Canada awarded to Prof. R. B Thomson, 271
Flax · Control of Foot Rot (*Phoma* sp) of (A E Muskett and J. Colhoun), 538
Fleas . A Simple Trap for Catching (A. H. Al-Hussaini), 501
Flies Breeding in Percolating Sewage Filters : Control by D.D.T. of (T. G. Tomlinson), 478
Flight of Bats · Acoustic Control in the (Prof. H. Hartridge), 490, 692 ; (A. J. Wilmott), 687 ; (Dr. D. W. Ewer), 692 ; (Flight-Sergt. Martin Wilkinson), 693
Flora of Familiar English Plants, *review* by Prof F J. Lewis, 461
Flora of South Africa (Intertidal Fauna and) · The Constitution of the (Prof. T. A. Stephenson), Part 2, 27
Flow of Water through Very Narrow Channels and Attempts to Measure Thermomechanical Effects in Water (Dr. J. Reekie and J. Aird), 367
Flowering of Horse-Chestnut : Late (Dr. Julian Huxley), 574 ; (Miss E M Blackwell), 721 ; (Dr. H. G. Baker), 721
Flowers · Common Wild (John Hutchinson), *review* by Prof F. J. Lewis, 461
Fluorescence of Dipropyl Ketone at Low Temperatures (Dr. S C. Sirkar and B. M Bishui), 333
Fluorescence Microscopy of Tubercle Bacilli (Dr. B. Juricic, Sr. Nicolás Vuskovic, Dr. Gastón González, Dr. Hernán Durán and Dr. Hipólito Vergara), 16
'Fly's Eye' : X-Ray Analysis with the Aid of the (Sir Lawrence Bragg and A. R. Stokes), 332
Foie : A propos d'un procédé d'exploration simple de l'état fonctionnel du (J. Bailly and G. Decrop), 395
Folk-Lore of Toothache (Dr. J. D. Rolleston), 387
Fonctions : Théorie des (Prof. Georges Valiron), *review* by Prof. H. T H. Piaggio, 648
Food (Minister of) · If I were, in Peace-time (Sir John Boyd Orr), 292
Food for Cattle · Use of Trees and Shrubs as, 151
Food Consumption : Family, in the United States (Miss M. W. Grant), 441
Food Intake · Effect of Restriction of, upon the Incisor Teeth of Rachitic Rats (Prof. J T. Irving), 664
Food Policy in Britain, 292
Food Science, *review* by Dr T. Moran, 220
Food and Food Products : The Chemistry and Technology of (edited by Dr. Morris B. Jacobs), Vol 2, *review* by Dr. T. Moran, 220
Foods (African Fermented) : B Vitamins in (Dr. Leon Golberg, J. M. Thorp and Sheila Sussman), 364
Foods (Proteins and) : The Amino Acid Composition of (Dr. Richard J. Block and Diana Bolling), *review*, 33
Foods (War-time) : Nutritive Values of (Medical Research Council War Memorandum No. 14), 330
Foot Rot (*Phoma* sp.) of Flax : Control of (A. E. Muskett and J. Colhoun), 538
Foreign Policy : Science and (G. Fielding Elliot), 63
Forest Policy in India . Post-War (Prof. E. P. Stebbing), 286
Forestry Economy of Madras : Agricultural and (J A Wilson), 151
Forestry Problems in the United States, *review* by Prof. F. J Lewis, 584
Forests : The Hazel Period in the Post-Glacial Development of (Prof. Felix Rawitscher), 302
Forests of New Zealand . Indigenous (Prof. E. P. Stebbing), 60
Fourier Systems · Accuracy of Atomic Co-ordinates Derived from (A. D Booth), 51
Fourier Transformer . A Photo-Electric (Prof. Max Born, Dr. R. Furth and R. W. Pringle), 756
Fovea Centralis : Colour Sensitivity of the (E. N. Willmer and W. D. Wright), 119
Fowl : An Induced Carcinoma in the (F. Bielschowsky and Prof. H. N. Green), 780
France : Reorganization of Museums in, 641
Franklin Medal Lecture on Atomic Energy as a Human Asset (Dr. Arthur H. Compton), 687
Fredericq (Léon) et les débuts de la physiologie en Belgique (Prof. Marcel Florkin), *review* by Prof. C. Lovatt Evans, 764
Freedom of Scientific Intercourse, 215
Freedom for Scientific Research (Lord Brabazon of Tara), 746
French and German Geographical and Geological Institutions : Some (Dr. John W. Wells), 243
Frictional Properties of Wool Fibres (M. Lipson), 268
Friedel-Crafts Catalysts in Carbon-Monoxide Reactions (Dr. P. H. Sykes), 638
Friedel-Crafts Catalysts and Polymerization (Department of Chemistry, University of Manchester conference on), 232, 638
Frost · Use of Growth-Promoting Substances in the Prevention of Apple Drop following (T. Swarbrick), 691
Frost Injury Simulating Virus Disease Symptoms on Potato Foliage (Robert McKay and Dr. Phyllis E. M. Clinch), 449
d-Fructofuranose and *d*-Glucose : Yeast Hexokinase and its Substrates (Dr. A. Gottschalk), 540
Fruit Growers' Conferences · Vegetable and (edited by Dr. D H. Robinson), *review*, 489
Fruit Storage and Transport : Use of Carbon Dioxide in (F. Gerhardt, E. Smith and H. English), 178 ; (A. V Doreen, M. B Hoffman and R. M. Smock), 178 ; (F. W Allen, W. T. Pentzer and C. O. Bratley), 178 ; (W. T. Pentzer and F. W. Allen), 178
Fruit Trees : Phosphorus Deficiency of (L. R. Bryant and R. Gardner), 178
  Root Distribution of (E. L Proebsting), 395
Functional Condition of the Liver Examining the, 395
Functions of a Complex Variable, *review* by J. H. Pearce, 67
Fungi : Trees and, *review*, 732
Fungi in Wareham Heath Soil . Origin of Toxicity to (Dr. M. C. Rayner), 174
Fungistatic Factors : A Thermostabile, from *Escherichia coli* (Sten Wiedling), 204
Fungistatic Substance ·, Viridin, a Highly, produced by *Trichoderma viride* (Dr. P. W Brian and J. C. McGowan), 144
Funktionen (elliptische) : Vorlesungen uber allgemeine Functionentheorie und (Prof Adolf Hurwitz), dritte auflage, *review* by J. H. Pearce, 67
Funktionentheorie und elliptische Funktionen : Vorlesungen uber allgemeine (Prof Adolf Hurwitz), dritte auflage, *review* by J. H. Pearce, 67
Fusarium oxysporum cubense : Inhibition of the Development of, by a Growth Substance produced by Meredith's Actinomycetes (Dr. A. C. Thaysen and K R. Butlin), 781

GARDEN Birds (Phyllis Barclay-Smith), *review*, 34
Garden Book . Thomas Jefferson's, 1766–1924, with Relevant Extracts from his other Writings (annotated by Prof. Edwin Morris Betts), *review* by Dr. E. J. Salisbury, 128
Garden Gate : Through my (Newman Flower), *review*, 614
Gases : Effect of Pressure on Thermal Diffusion in (K E. Grew), 267
  (High-Pressure) Afterglow Effects in (Dr. J. D Craggs and Dr. J. M. Meek), 21
  (Hot) : Production of Skin Burns by (O. M. Lidwell), 298
  (Inert) : The Spectral Structure of the (Prof. Bengt Edlén), 445
Gastric Mucosa · A Theory of the Formation of Hydrochloric Acid in the (Prof. E J Conway, O. FitzGerald and D Watts), 477
Geddes, Patrick (Philip Boardman), *review* by R. Brightman, 612 ; *erratum*, 687
Geiger-Muller Counter (Fast) · Effect of the Pressure of Alcohol Vapour on the Operation of the (Dr. G. D Rochester and C. B. A. McCusker), 366
Genetic Types of Manganese Deposits (Prof Arthur Holmes), 87
Genetics and Major Evolutionary Change, *review* by Dr. Julian S. Huxley, 3
Geographer as Humanist (Prof. W. Fitzgerald), 355
Geographical and Geological Institutions : Some French and German (Dr. John W. Wells), 243
Geography in New Zealand, 44
Geological Features in England and Wales : Care of, 485
Geological Institutions (Geographical and) : Some French and German (Dr John W. Wells), 243
Geological Survey (Colonial) . The Contribution of, to the Development of the Mineral and other Resources of East and West Africa (Sir Edmund Teale), 167
Geology of the Nubian Sandstone (Dr. N M. Shukri), 116
Geology and Palæobotany in the U S S.R (W. N. Edwards), 282
Geometrische Funktionen : Abschnitt uber (Prof. R. Courant), *review* by J. H Pearce, 67
Germ Cells in Teleosts · Sexual Differentiation of the Gonad and the Sexualization of the (Prof. Umberto D'Ancona), 603
German Economic Sphere . The Danube Basin and the (Dr. Antonin Basch), *review* by Capt. Maurice Bruce, 551
German Geographical and Geological Institutions : Some French and (Dr. John W Wells), 243
German Men of Science to be taken to the United States, 445
German Military Maps (Royal Geographical Society exhibition of), 445
German Occupation : Bread in Jersey during (Dr. D. W Kent-Jones and Dr. A. J. Amos), 336
German University in Prague : Closing of the, 502
Germany : The Regions of (Dr. Robert E. Dickinson), *review* by Prof. W. Fitzgerald, 253
Germany and Europe (Dr. F. Darmstaedter), *review* by Capt. Maurice Bruce, 551
Germany and Japan : The Control of (Dr. Harold G. Moulton and Dr. Louis Marlio), 64
Germination of Bearded Iris Seeds (L. F. Randolph and L G. Cox), 395
Giant's Causeway : The (Prof. Arthur Holmes), 425
Gigartina stellata : A Polysaccharide from—the Isolation of Crystalline 2 : 6-Dimethyl-*β*-*d*-Galactopyranose from the Methylated Polysaccharide (Eric T. Dewar and Dr. E. G V Percival), 633
Glacial Times : Lowering of Sea-Level in (A. Farrington), 396
Glass · Strength of, and Duration of Stressing (F. W. Preston), 55
Glass Houses : People Who Live in (A V D. Orderly), 501
Glasses : The Bates Method for Good Sight without (Dr. William H. Bates), *review*, 281
Glide in Metal Single Crystals · Effect of Alpha-Ray Bombardment on (Prof. E. N. da C. Andrade), 113
Glioma in a Rat Fed with 2-Acetyl-amino-fluorene (Dr. E. Vazquez Lopez), 296
Glow Discharge · Visible, at Very Low Potentials (Dr. A Sommer), 242
d-Glucose : Yeast Hexokinase and its Substrates *d*-Fructofuranose and (Dr. A. Gottschalk), 540
Glue : Wood and (Dr. M. C. Pryor), 306
Glycerides of Rape (*Brassica napus* L.) Leaf : Occurrence of Hexadecatrienoic Acid in the (Dr. F. B. Shorland), 269
God : Science and the Idea of (William Ernest Hocking), *review*, 281
Gonad : Sexual Differentiation of the, and the Sexualization of the Germ Cells in Teleosts (Prof. Umberto D'Ancona), 603
Gonadal Hormones : Relation of the, to certain Dermatoses (Dr. Georges Garnier), translated by Major James Marshall, 339

Good and the Clever The (Master of Balliol), 744
Government Control in War (Lord Hankey), 457
Government Scientists A New Deal for, 644
Government Support for Research Associations in Britain (Herbert Morrison), 597
GR-S : The Behaviour of Natural Rubber and, under Repeated Stress Cycles (Dr. D. Parkinson and J L. Bloxham), 11
  Weathering of (H. C. Harrison), 10
GR-S Vulcanisates : The Heat Ageing of (Dr J. R. Scott), 10
Gram-positive Complex in Micro-organisms · Nature of the (Dr. H. Henry, Dr. M Stacey and Dr Ethel G. Teece), 720
Granules of the Human Polymorphonuclear Leucocyte (Major J. F. A. McManus), 173
Grass : Thatch (Dr. B. C. Sharman), 342
  (Dried) Determination of β-Carotene in (T. Barton Mann and W. M Seaber), 571
Grasses · Californian Marine Algæ and, 533
Gravitation : A Classical Theory of Electromagnetism and (Dr. H. C. Corben), 388
  The Two-body Problem in Milne's Theory of (G. J. Whitrow), 365
Great Britain Dental Teaching and Research in (Nuffield Foundation to make grants for), 417
  Industrial Research in, 711
  Medical Films in (Royal Society of Medicine in co-operation with the Scientific Film Association to prepare a catalogue of), 387
  Penicillin Production in, 386
  The Recruitment and Training of Plant Pathologists in (Association of Applied Biologists), 724
  Research in Animal Breeding and Genetics in, 231
  The Teaching of Analytical Chemistry in, with special reference to Microchemistry (Dr Cecil L. Wilson), 588
  See *also under* Britain
'Green Flash' at Sunset with a near 'Horizon' (D. R. Barber), 146 ; (Dr. C. E. P. Brooks), 368
Green Mansions : Behold our (Richard H D. Boerker), *review* by Prof. F. J. Lewis, 584
Growth *in vitro* of Acid-fast Bacteria · Inhibitory Action of Dialkyl Succinic Acid Derivatives on the (Vincent C. Barry and Dr. P. A. McNally), 48
Growth of Bone : Recent Investigations on the (Prof. P Lacroix), 576
Growth-Factors and Growth Inhibitors for Micro-organisms (Dr. B. C. J. G. Knight), 86
Growth Inhibition in Pea Seedlings (E. Dorothy Brain), 397
Growth Inhibitors : Growth-Factors and, for Micro-organisms (Dr. B. C J. G Knight), 86
Growth-Inhibitors of the same Bacilli : Fatty Constituents of Tubercle Bacilli as (Dr. Ng. Ph Buu-Hoï), 392
Growth-Promoting Substances in the Prevention of Apple Drop following Frost : Use of (T. Swarbrick), 691
Growth Substance produced by Meredith's Actinomycetes : Inhibition of the Development of *Fusarium oxysporum cubense* by a (Dr. A C. Thaysen and K. R. Butlin), 781

HAEM-AGGLUTININS (Immune) . Enhancement of the Action of, by Human Serum (K. E. Boorman, B. E Dodd and Dr. W. T. J. Morgan), 663
Hæmocyanin Molecules · Electron Shadow-Micrographs of (Prof. Robley C. Williams and Dr. Ralph W. G. Wyckoff), 68
Hæmoglobin in Blood-sucking Parasites (Prof. H. Munro Fox), 475
Hæmoglobins . Individual (Prof. H. Munro Fox), 18
Hæmolytic Substance . Crystalline, from Normal Blood (Dr. H. Laser and Dr E. Friedmann), 507
Halides · The Catalytic (Dr. F. Fairbrother), 638
  (Catalytic) : The Molecular Structure of the (Dr. H. A. Skinner), 638
Halogenation in the Allyl Position (Dr. William E. Vaughan, Frederick F. Rust and George W. Hearne), 53 ; (Dr. W. A. Waters), 53
Hamsters infected with *Leishmania* : Œdema in (L. G. Goodwin), 476
Haploid-Diploid Twin Embryos in Angiosperms : Origin of (Dr. P. Maheshwari), 173
Harmonics in the Piezo-Electric Oscillation of a Quartz Crystal (L. C. Tsien and H. C. Chu), 424
Harmonics (Spherical) : The Theory of Potential and (Wolfgang J. Sternberg and Prof. Turner L. Smith), *review* by J. H. Pearce, 5
Hartley (Marcellus) Public Welfare Medal for 1945 of the United States National Academy of Sciences awarded to Dr. Vannevar Bush, 575
Harvest : Four Years (Frances Donaldson), *review* by Sir John Russell, 280
Hatching of the Egg of *Ixodes ricinus* L. (D. R. Arthur), 538
Hay-fever Plants (Roger P. Wodehouse), *review* by Dr. H. Godwin, 317
Hazel Period in the Post-Glacial Development of Forests (Prof. Felix Rawitscher), 302
Healing : British Achievement in the Art of (John Langdon-Davies), *review* by Dr. G. Lapage, 350
Health : The Animal in, *review* by Dr. John Hammond, 377
Health Research in Industry (Dr. G. Lapage), 148
Health and Disease : The Child's Blood in, *review* by Prof. Thos. B. Davie, 192
Heart : Transplantation of the (Prof. Nikolai Sinitsin), 536
Heat : A Text-Book of (G. R. Noakes), *review*, 377
Heat of Atomization of Carbon : Energy of the Hg—C Bond and the (Prof. N. V. Sidgwick and H. D. Springall), 599
Heat Ageing of GR-S Vulcanisates (Dr. J R. Scott), 10
Heat Coagulation of Muscle Proteins (Dr. E. C. Bate-Smith and J. R. Bendall), 632
Heat Injury in Insects (G. T. Jefferson), 111
Heaviside's Operational Calculus Made Easy (Dr. T H. Turney), *review* by Dr. L. E. C. Hughes, 6
Helminths : A Medium for Mounting Parasitic (Dr. Fei-pai Li and Fu-si Yang), 297 ; (Dr. G. Lapage), 298
Helvolic Acid : Activity of, against *Mycobacterium tuberculosis* (M. A. Jennings), 633
Hen : Life-Cycle of the Red Corpuscles of the (Prof. G. Hevesy and J. Ottesen), 534
Heterogeneity of Human Serum Albumin (H. Hoch and C. J O. R. Morris), 234
Heterokaryosis and the Mating-Type Factors in *Neurospora* (Eva Sansome), 47
Hexachlorocyclohexane as an Insecticide (L. B. Bourne), 85 ; (Sidney Rogerson), 424
Hexadecatrienoic Acid in the Glycerides of Rape (*Brassica napus* L.) Leaf : Occurrence of (Dr. F. B. Shorland), 269
High Polymer Bulletin . Publication of a, 167
High-Pressure Gases : Afterglow Effects in (Dr. J. D. Craggs and Dr. J. M. Meek), 21
Highland Year A (Seton Gordon), *review* by Dr. F. Fraser Darling, 219
Histological Fixation of Locomotory Patterns (H. W. Lissmann), 391
Histological Sections : Double-Refringence of the Amyloid-Congo-Red-Complex in (Dr. Peter Ladewig), 81
Histology : Morbid, of the Eye, *review*, 279
Historical Background of Planning, 166
History and Philosophy of Science, 532
H.M. Forces : Education in, 107
Holland and Denmark : Books and Journals for, 263
Horizon (near) · The 'Green Flash' at Sunset with a (D. R. Barber), 146 ; (Dr. C. E. P. Brooks), 368
Hormones (Gonadal) · Relation of the, to certain Dermatoses (Dr. Georges Garnier), translated by Major James Marshall, 339
Horse-Chestnut · Late Flowering of (Dr. Julian Huxley), 574 ; (Miss E. M Blackwell), 721 ; (Dr. H. G. Baker), 721
Hospital Diet (Dr. G. Lapage), 725
Housefly . Toxicity of D.D.T. to the (E. A. Parkin and A A Green), 745
Hughes Medal of the Royal Society awarded to Prof. B F. J. Schonland, 596, 696
Human Adults : Vitamin A Deficiency and the Requirements of, 11
Human Biology : Abstracting Service for, 714
Human Chromosomes (Prof. M. E. Varela), 755
Human Conflicts : Foundations of (Dr. William A. Brend), *review* by Dr. William Brown, 314
Human Disease : Tyroglyphid Mites and (Dr. G. Lapage), 427
Human Embryo : The Early, *review* by Dr. C. H. Waddington, 375
Human Embryology (Prof. W. J. Hamilton, Prof. J. D. Boyd and Prof. H. W. Mossman), *review* by Dr. D. V Davies, 315
Human Nutrition : Fermentation and (Dr. B. S. Platt), 87
Human Polymorphonuclear Leucocyte . Granules of the (Major J. F. A. McManus), 173
Human Sense Organs : Conditioned Excitors and (Prof. Krikor Kekcheyev), 573
Human Serum . Enhancement of the Action of Immune Hæm-Agglutinins by (K. E. Boorman, B E. Dodd and Dr W. T. J Morgan), 663
Human Serum Albumin : Heterogeneity of (H. Hoch and C. J. O. R. Morris), 234
Human Speech Good Enough ? : Is (Sir Richard Paget), 209
Human Urines · Primary Degradation Products of Mepacrine in (D. Ll Hammick and S F. Mason), 718
Humanist : The Geographer as (Prof. W Fitzgerald), 355
Humanities : Medicine and the, *review* by Dr. G. Lapage, 488
Husserl (Edmund) and the Quest for a Rigorous Science of Philosophy : The Foundation of Phenomenology—(Prof. Marvin Farber), *review* by F. Ian G. Rawlins, 516
'Hybrid' Crystals of Potassium Dihydrogen Phosphate : Laue Photographs of Sub-crystalline Regions in (Dr. A. R. Ubbelohde and Miss I. Woodward), 20
Hydration of Enzyme Protein : Cell Proliferation, Carbohydrate Breakdown and (Dr. A. Lasnitzki), 398
Hydrocarbon Compounds : Encyclopedia of (Dr. Joseph E. Faraday), Replacement-addition issue of C_1 to C_8, 744
Hydrochloric Acid in the Gastric Mucosa : A Theory of the Formation of (Prof E. J. Conway, O. FitzGerald and D Watts), 477
Hydrochloric Acid for Softening Algal Tissues for Microtome Sections : Use of (Dr. Kathleen M. Drew), 479
Hydrogen Bond Linking of Quinol Molecules (D. E. Palin and H M. Powell), 334
Hydrogen Ion Concentration and Similar Quantities · Symbols Used to Indicate (Dr. D. Clibbens), 176
Hydrogen Overvoltage as a Factor in the Corrosion of Metallic Couples (L. F. LeBrocq and H. C. Cocks), 536
Hydrography (Marine) : Ceratium and (Prof. F. E. Fritsch), 181
Hygiene : Milk, *review*, 406
Hylemyia cinerella Fallen : Bionomics of (Dr. M. Hafez), 48
Hyrax Hill, Nakuru, Kenya Colony, 1937–1938 : Report on the Excavations at (Mary D. Leakey), 722
Hysteresis in the Adsorption of Water Vapour by Wheat (Dr. J. D. Babbitt), 265

IDENTIFICATION Purposes : Index of Data for (Dr. A. F. Wells), 535
Identity : Crystallization and, of the Triose and Triosephosphate Dehydrogenases of Muscle (Ranwel Caputto and Dr. Malcolm Dixon), 630
Illusion of Size (Prof. H Hartridge), 118, 636 ; (J. Phelps), 269 ; (Robert Weil), 636
Imitation : Experimental, of Tumour Conditions (Dr. P. T. Thomas), 738
  Social Learning and (Neal E. Miller and John Dollard), *review* by Dr. John Cohen, 515
Immune Hæm-Agglutinins : Enhancement of the Action of, by Human Serum (K. E. Boorman, B. E. Dodd and Dr. W. T. J. Morgan), 663
Immune Reactions . Comparison of Enzyme and, *review* by Dr. P. Johnson, 517
Immuno-Catalysis (Prof. M G. Sevag), *review* by Dr P. Johnson, 517
Impedance Bridge with a 10^6 to 1 Range (H. T. Wilhelm), 639
Imperata cylindrica (Imperial Agricultural Bureaux Joint Publication No. 7), 342
Imperial Chemical Industries Fellowships at Cambridge, 17
Imperial College : The City and Guilds College—Engineering at the (Prof. E. F. D Witchell), 650
  Physics and Astrophysics at the (Prof. Herbert Dingle), 562

Inactivation : Anomalous, of Heavy Metal Antifouling Paints (Prof John E. Harris), 206
Incisor Teeth of Rachitic Rats : Effect of Restriction of Food Intake upon the (Prof. J. T. Irving), 664
Indexes of Data for Identification Purposes (Dr. A. F. Wells), 535
India : Fellowship for Scientific Research in, 107
  National Physical Laboratory for, 15
  Peoples of (Wm. H. Gilbert, jr.), 292
  Post-War Forest Policy in (Prof. E. P. Stebbing), 286
  Science and Education in, 291
  Symposium on, *review* by Prof J H. Hutton, 66
India and the British Colonies : Scientific Research in, 758
Indian Fishes and Fisheries (Dr. Sunder Lal Hora), 511
Indian Plywood Tea Chests : The Testing of (V. D. Limaye), 668
Individual Hæmoglobins (Prof. H Munro Fox), 18
Indoamericanismo y el Problema Racial en las Américas (Prof. Dr. Alejandro Lipschutz), segunda edicion, *review* by Prof. A. R. Radcliffe-Brown, 158
Indology and Oriental Culture (Royal Asiatic Society of Bengal conference on), 687
Industrial Research Bill, 625, 711
Industrial Research in Great Britain, 711
Industry : Health Research in (Dr. G. Lapage), 148
  Morale in, 91
  Some Problems of the Special Librarian in (E. N Simon), 605, 606
Industry in Australia : The Application of Science to (Sir David Rivett), 472
Industry (Scientific Instrument) : Man-Power and Training in the, 154
Inert Gases : The Spectral Structure of the (Prof. Bengt Edlén), 445
Infant's Mind : Measuring the, *review* by Dr John Cohen, 349
Inferiority Complex and the Paranoid Tendency, with a Brief Reference to Nazi Psychology (Dr. William Brown), 259
Information Service as an Essential in the Progress of Science (Prof. J. B. Bernal), 605
Infra-red Absorption : Chemical Analysis and Structural Diagnosis by, *review* by Dr. H. W. Thompson, 65
Infra-red Spectra of Coals (C. G. Cannon and Dr. G. B. B. M. Sutherland), 240
Infra-red Spectra of Rock-salt : Raman and (Dr. R. S. Krishnan), 267
Infra-red Spectroscopy (R. Bowling Barnes, Robert C. Gore, Urner Liddel and Van Zandt Williams), *review* by Dr. H. W. Thompson, 65
Infra-red Spectrum of Diamond (K. G. Ramanathan), 23
Infra-red Spectrum of the Night Sky (R. Herman, L. Herman and J Gauzit), 114
Inheritance of Melanism in Grey Squirrels (Monica Shorten), 46
Inheritance and Acquired Characteristics (Prof. Wm. Rowan), 236
Inhibition of the Development of *Fusarium oxysporum cubense* by a Growth Substance produced by Meredith's Actinomycetes (Dr. A. C. Thaysen and K. R Butlin), 781
Inhibitory Action of Dialkyl Succinic Acid Derivatives on the Growth *in vitro* of Acid-fast Bacteria (Vincent C. Barry and Dr. P. A. McNally), 48
Injury : Heat, in Insects (G T. Jefferson), 111
  (Major) : Survival of a Fish after a, 714
Innes (John) Horticultural Institution, 586
Inorganic Ions : The Active and Passive Exchanges of, through the Surfaces of Living Cells and through Living Membranes Generally (Prof. August Krogh), 542
Inorganic Salt Solutions : Cytological Reactions Induced by (Albert Levan), 751
Insect Physiology and Toxicology : Enzyme Activity as a Factor in (Dr. H. Hurst), 194
Insect Punctures (*Dysdercus* sp.) : Control of Internal Boll Rot of the Cotton Plant, caused by, through Selection of Resistant Strains (Prof. Teodoro Boza Barducci, Prof. Germán García Ráda and Prof. Johannes Wille), 235
Insect and Plant Pests . Biological Control of (Dr. W R. Thompson), 271
Insecticidal Action of D D.T. (J. R. Busvine), 169
Insecticidal Properties of *Euphorbia* Extracts (F. L. Vanderplank), 782
Insecticide . Hexachlorocyclohexane as an (L. B. Bourne), 85 ; (Sidney Rogerson), 424
Insecticides, 168
Insecticides (Contact) : Mode of Entry of (W. H. Potts and F. L. Vanderplank), 112 , (Dr. N. E. Hickin), 753
Insects . Heat Injury in (G. T. Jefferson), 111
Instability of Dienœstrol and Stilbœstrol Solutions (A. E. Wilder Smith and P. C. Williams), 718
Instrument Jewels and Pivots : Meter and (G. F. Shotter), 89
Instruments : Moving-Coil (G. F. Tagg), 396
Integration . Compromise and (Colonel L Urwick), 93
Intelligence Tests for Young Children (Prof. C. S. Valentine), *review* by Dr. John Cohen, 349
Interfaces . Reactions at, and their Significance in Biology (Dr. J. F. Danielli), 468
Interfacial Tension and Density *in* Solutions : Time Dependence of (Prof. George Antonoff), 301
Interference Effect : A New (F. K. Bauchwitz and D. Shoenberg), 142
International Collaboration, 78
International Co-operation in Social and Economic Fields, 231
International Labour Office . The New (British Association for Labour Legislation), 231
International Morality : The Problems of Education in (United Nations Fellowship discussion on), 444
International News, Bulletin of . To be replaced by *The World To-day*, 167
International Science Co-operation Service, 401
International Scientific Commission : A Permanent (Prof. J. D. Bernal), 557
International Scientific Co-operation in Post-War World Organisation : The Place of Science and (Dr. Joseph Needham), 558
Interpretation of Fantasy as a Clinical Technique, *review* by Dr. John Cohen, 701
Inverse Binomial Sampling (Dr. R. A. M Case), 115
Iodine : Emission Bands of the Fluctuation Type in the Spectrum of (Prof. R. K. Asundi and P. Venkateswarlu), 452
Ionic Migration In Molten Salts : Activation Energy of (Dr. E. Heymann and H. Bloom), 479
Ions and Dipolar Ions : Proteins, Amino-Acids and Peptides as (Edwin J. Cohn and John T. Edsall), *review* by Dr. Kenneth Bailey, 405
Ions (Inorganic) : The Active and Passive Exchanges of, through the Surfaces of Living Cells and through Living Membranes Generally (Prof. August Krogh), 542
Ireland : Occurrence of the Diphyllobothriidæ in (J R. Harris and Dr. M. D. Hickey), 447
Iris Seeds (Bearded) : Germination of (L. F. Randolph and L. G. Cox), 395
Irish Rivers : Previously Spawned Salmon In (Arthur E. J W ent), 178
Iron in Peroxidase : Can the, be Replaced by Manganese ? (Prof. Hugo Theorell), 474
Iron Age (Early) A Find of the, from Llyn Cerrig Bach, Anglesey (Sir Cyril Fox), 309
Iron Age Finds from Anglesey (M. C. Burkitt), 309
Ischæmic Muscle : Synthesis of Adenosine Triphosphate by an Enzyme System from (Marian Bielschowsky and Prof. H. N. Green), 117
Isle of Wight : Earthquakes recorded by E. W. Pollard, during March, 79 ; during April and May, 201 ; during June, 545 ; on November 27, 712
Isoclinics in Photo-elastic Methods : A Photographic Method of deriving (B. Dunn), 480
Isomeric Mepacrines (Optically) : Properties of (Prof. G. F. Gause), 784
Ixodes ricinus L. : Hatching of the Egg of (D. R. Arthur), 538

JAMAICA : Nutrition In, 288
Japan (off the coast of) : Earthquake on January 12, 79 ; on February 10, 79
Japan (Germany and) : The Control of (Dr. Harold G. Moulton and Dr. Louis Marlio), 64
Jefferson's (Thomas) Garden Book, 1766—1824, with Relevant Extracts from his other Writings (annotated by Prof. Edwin Morris Betts), *review* by Dr. E. J Salisbury, 128
Jersey during German Occupation . Bread in (Dr. D W. Kent-Jones and Dr. A J. Amos), 336
Jet Propelled Aircraft : Air Speed Record by (Group-Captain H J. Wilson), 597
Jewels and Pivots : Meter and Instrument (G. F. Shotter), 89
Jews and Medicine (Prof. Harry Friedenwald), *review* by Dr Walter Pagel, 31
Jones-Bateman Cup for original research in fruit culture (Royal Horticultural Society), 17
Journal of the Chinese Chemical Society : Volumes for the years 1941–44, 511
Journals : Books and, for Holland and Denmark, 263

KALA Azar : Penicillin in (Dr. E. S Horgan and Mohamed Hamed Satti), 297
Kamchatka : Volcanological Station at (V. I. Vlodavetz), 640
  (east of) : Earthquake on April 15, 201
Kaolinite . Structure of (Dr. G. W. Brindley and Keith Robinson), 661
Kew : Botanist for India at, 444
Kilimanjaro—Crater Fumaroles of Kibo and Seismic Activity during 1942–45 (J J Richard), 352
Kinematical Relativity (Prof. E. A Milne), 747 ; (Prof. Herbert Dingle), 748
  Cosmic Rays and (Prof. J. B S. Haldane), 266 ; (Prof. Herbert Dingle), 389
Knowles (Lees) Lectures, 1945 (Lord Hankey), 457
Koch Bodies of *Theileria annulata* : Multiplication *in vitro* of (I. Tchernomoretz), 391
Kweichow and Kuangsi : Science in (Dr. Joseph Needham), 496

LACTATION in the Rat : Parathyroidectomy (A. T. Cowie and Dr. S. J. Folley), 719
Lakes : Archives of the (Dr. H. Godwin), 383
Land Use Demobilization, Rehabilitation and, 429
  Natural Principles of (Edward H. Graham), *review* by Sir John Russell, 675
Lands (Many) : Faiths of (E. Royston Pike), *review* by Enid Blyton, 34
Landscape Forms : Volcanoes as (Prof. C. A. Cotton), *review* by Prof. Arthur Holmes, 156
Lantern Slides of Line Drawings (Dr. G. D. Yarnold and L. Heath), 574
Larke (Sir William J), Medal of the Institute of Welding for 1945 awarded to W. K. B Marshall, 473
Latin America Plants and Plant Science in (edited by Frans Verdoorn), *review*, 676
Laue Photographs of Sub-crystalline Regions in 'Hybrid' Crystals of Potassium Dihydrogen Phosphate (Dr. A. R. Ubbelohde and Miss I. Woodward), 20
Lead Intensifying Screens : 'Electron Radiography' using Secondary β-Radiation from (H. S. Tasker and S. W. Towers), 50
Leaf : Physical Conditions of the Surface of the Mesophyll Cell Walls of the (Prof Francis J. Lewis), 407
Legume Nodule Bacteria . Effective and Ineffective Strains of (Dr. H. G. Thornton), 654
Leishmania : Œdema in Hamsters Infected with (L. G. Goodwin), 476
Leishmania Infections : Penicillin in (J D. Fulton), 203
Lend-Lease, Weapon for Victory (E. R. Stettinius), 78
Leucocyte (Human Polymorphonuclear) : Granules of the (Major J. F. A. McManus), 173
Libraries University and Research (Library Association conference on), 417
Library Technique (Special) : Manual of (J. E. Wright), *review* by R. Brightman, 406
(Lichtenberg Figures) : Electric Discharge on a Dielectric Surface (A. Morris Thomas), 451
Life : Low-Temperature Limits of (S. A Zernov and O. I. Schmalhausen), 304
Life of Woodlice : Duration of (Dr Walter E. Collinge), 755

- Life-Cycle of the Red Corpuscles of the Hen (Prof. G. Hevesy and J. Ottesen), 534
- Light Sensitivity : Absolute and Differential, of the Dark-Adapting Eye (Dr. H Pollak and D. G. Wilson), 299
- Lightning · Ball, 293
- Lignification : Abnormal, in the Wood of some Apple Trees (Dr. A. Beryl Beakbane and Dr. Eleanor C. Thompson), 145 ; *erratum*, 202
- Linnæus : A Recently Discovered Manuscript by (Dr. Anders Grape), 351
- Linoleic Acid : Autoxidation of (Sune Bergstrom), 717
- Liquid Metals : Electrical Resistance of (Prof. K. S. Krishnan and A. B. Bhatia), 503
- Liquids : Viscosity of Ordinary, at High Rates of Shear (L. Grunberg and Dr. A. H. Nissan), 241
- Liquids and Colloidal Solutions : Viscosity of (Academy of Sciences of the U.S.S R. conference on), 147
- *Lithobius forficatus* : Behaviour of the Common Centipede (Capt. J. L. Cloudsley-Thompson), 537
- Liver : Examining the Functional Condition of the, 395
- Livers of Pellagrins : Porphyrin Fluorescence in the, in relation to Ultra-Violet Light (Dr. J. Gillman, Dr. T. Gillman and S Brenner), 689
- Liversidge Lecture (Prof. E. K Rideal), 468
- Living Cells : The Active and Passive Exchanges of Inorganic Ions through the Surfaces of, and through Living Membranes Generally (Prof. August Krogh), 542
- Living Eye : Measurement of the Diameters of the, by means of X-Rays (Prof. Arnold Sorsby and A. D. O'Connor), 779
- Llyn Cerrig Bach, Anglesey : A Find of the Early Iron Age from (Sir Cyril Fox), 309
- Locomotory Patterns : Histological Fixation of (H. W. Lissmann), 391
- Locust (Desert) · Presence of Reddish Pigment in Eggs and Ovarioles of the, and its Probable Phase Significance (Dr. M. L. Roonwal), 19
- Locust Swarms in relation to Temperature . Mass Departure of (Dr. D L. Gunn, Flying-Officer F. C. Perry, Flight-Lieut. W. G. Seymour, Flight-Lieut. T. M. Telford, A.C.2 E N. Wright and D. Yeo), 628
- Logarithmic Scales (F. Campbell Rose), 268
- Lognormal Distributions (Prof. J. H. Gaddum), 463, 747 ; (Dr. Percival Allen), 746 , (S C. Pearce), 747
- Long-Wave Solar Radiation from Black-Body Intensity : Departure of (Sir Edward Appleton), 534
- Lord and Taylor Annual American Design Award for 1945 presented to the United States National Academy of Sciences, 575
- Low-Temperature Limits of Life (S. A. Zernov and O. I. Schmalhausen), 304
- Low Temperatures ,Fluorescence of Dipropyl Ketone at (Dr. S. C. Sirkar and B. M. Bishui), 333
- Lubrication of Metal Surfaces by Fatty Acids (Dr. F. P Bowden, J. N. Gregory and Dr. D. Tabor), 97
- Luminosity of Coal Gas Flames : Influence of Sulphur Oxides on the (Dr G. Whittingham), 207

- MACROSSAN (John Murtagh) Memorial Lectures (Sir David Rivett), 472
- Madras : Agricultural and Forestry Economy of (J. A. Wilson), 151
- Magendie, François—Pioneer in Experimental Physiology and Scientific Medicine in Nineteenth Century France (J. M. D. Olmsted), *review* by Prof. E. D. Adrian, 316
- Magnesium and its Alloys : Metallography of (Walter Bulian and Eberhard Fahrenhorst), translated by the Technical Staffs of F. A. Hughes and Co., Ltd., and Magnesium Elektron, Ltd., *review*, 614
- Magnetic Susceptibility of Molybdenite Crystals : Effect of Temperature on (Ajit Kumar Dutta), 240
- Magnetism : The Earth's (Prof. Sydney Chapman), 45
- Magnitudes of the Southern Comparison Stars for Eros : Re-Observation of the (R. H. Stoy and A. Menzies), 179
- Mammalian Striated Muscle · Regeneration of (Prof. W. E. Le Gros Clark), 109
- Mammary Cancer in Mice (Dr. E. Boyland), 787
- Mammary Tumours in Mice (Members of the Staff of the National Cancer Institute, United States Public Health Service), 787
- Man · Ecology in the Service of, *review* by Sir John Russell, 675
  - The Organisation of the Visual Cortex in (Dr Gordon Holmes), 201
  - Is the Progress of Science Controlled by the Material Wants of (Dr. F. Sherwood Taylor), 166
- Man and his Fellowmen (Dr. Samuel Lowy), *review* by Dr. J. Leycester King, 279
- Management of a Special Library, *review* by R. Brightman, 406
- Manganese ? : Can the Iron in Peroxidase be Replaced by (Prof. Hugo Theorell), 474
- Manganese Deposits : Genetic Types of (Prof. Arthur Holmes), 87
- Manganese Deposits of the U.S.S.R. (A. G. Betekhtin), 87
- Mankind : Medicine and (Arnold Sorsby), *review*, 129
- Man-Power and Training in the Scientific Instrument Industry, 154
- Man-Power and Resources (Scientific) : Committee on, 686
- Manuscript by Linnæus : A Recently Discovered (Dr. Anders Grape), 351
- Map of the British Isles, 16
- Maps : German Military (Royal Geographical Society exhibition of), 445
- Maps of Britain : National (Ministry of Town and Country Planning), 776
- Marine Algæ and Marine Grasses of San Diego, California : Annotated List of the (E. Yale Dowsen), 533
- Marine Cottid Fishes of California (Rolf L. Bolin), 395
- Marine Ecology in South Africa, 27
- Marine Hydrography : Ceratium and (Prof. F. E. Fritsch), 181
- Marine Organisms · Chemical Composition of (S. I. Tomkeieff), 607
- Matabeleland · Future of Electricity Supply in (A. R. Sibson), 168
- Material Wants of Man ? : Is the Progress of Science Controlled by the (Dr. F. Sherwood Taylor), 166
- Materials : Strength of (British Rheologists' Club conference on), 306
- Mathematics : Advanced, *review* by Prof. H. T. H. Piaggio, 648
  - (School) · A New Approach to, 330
- Mating-Type Factors in *Neurospora* : Heterokaryosis and the (Eva Sansome), 47
- Maturity (Mental) : The Concept of (Prof. A. W. Wolters), 494
- Measurement of High Voltages (Dr. J. M. Meek and F. W. Waterton), 422
- Measuring the Infant's Mind, *review* by Dr. John Cohen, 349
- Mechanical Test Results : Application of Statistical Methods to (Dr. B. Chalmers and E. R. W. Jones), 307
- Mechanism of the Beckmann Rearrangement (Flight-Lieut. Bryan Higman), 242 ; (M. J. S. Dewar), 688
- Mechanism of the Benzidine and related Rearrangements (M. J. S. Dewar), 784
- Mechanism of the Feulgen Reaction (J. G. Carr), 143
- Mechanism of Polymerization of Vinyl Compounds (Prof. H. W. Melville), 639
- Mechanization of Sugar Beet Production, 361
- Medical Exhibition . British, at the Sao Jose Hospital in Lisbon, 45
- Medical Films in Great Britain : Royal Society of Medicine in co-operation with the Scientific Film Association to prepare a catalogue of, 387
- Medical Research, Beit Memorial Fellowships for : Annual Report of the Trustees for the Year 1944–45, 140
  - Elections, 140
- Medical Research (Experimental) : Public Health and its Debt to (Sir William Savage), 417
- Medical Science : Achievement in, *review* by Dr. G. Lapage, 350
- Medicine . The Art of, in relation to the Progress of Thought (A. E. Clark-Kennedy), *review* by Dr. G. Lapage, 488
  - The Film in (Medical Committee of the Scientific Film Association discussion on), 426
  - The Jews and (Prof. Harry Friedenwald), *review* by Dr. Walter Pagel, 31
  - Nobel Laureates in, 533, 564
  - Travelling Fellowships in, 17
- Medicine in the United States : Practice of (Interim Report of the New York Academy of Medicine Committee on Medicine and the Changing Order), 341
- Medicine in the U.S.S.R. (Prof. Arnold Sorsby), 226
- Medicine and the Humanities, *review* by Dr. G Lapage, 488
- Medicine and Mankind (Prof Arnold Sorsby), *review*, 129
- Medicine (Biology and) : Direct Chemical Action upon Nerve Centres in (Prof. Lena Stern), 7
- Medium-Voltage Circuits : Over-Current Relays on (A G. Shreeve and P. J. Shipton), 305
- Melanin : A Neutral Solvent for (A. J. Lea), 478
- Melanism in Grey Squirrels . Inheritance of (Monica Shorten), 46
- Melanosis of Riehl-Poikiloderma (Cervico-Facial Pigmentation) (Dr. Georges Garnier), translated by Major James Marshall, 163
- Men who Habitually Squat : The Popliteal Facet in (Prof. M. A. Shah), 237
- Men of Science in the Modern State (Lord Winster), 231
- Mental Disorder · Biochemistry of (Psychiatry Section of the Royal Society of Medicine meeting on), 101
- Mental Maturity : The Concept of (Prof A. W. Wolters), 494
- Mepacrine on Diamine Oxidase : Action of (Dr. H. Blaschko and Ruth Duthie), 113
- Mepacrine in Human Urines : Primary Degradation Products of (D. Ll. Hammick and S. F Mason), 718
- Mepacrines (Optically Isomeric) : Properties of (Prof. G. F. Gause), 784
- Hg—C Bond . Energy of the, and the Heat of Atomization of Carbon (Prof. N. V. Sidgwick and H. D. Springall), 599
- $HgCl_2$ Vapour : Thermal Decomposition of (Dr. K. Wieland), 504
- Meredith's Actinomycetes : Inhibition of the Development of *Fusarium oxysporum cubense* by a Growth Substance produced by (Dr. A . C. Thaysen and K. R. Butlin), 781
- Merino : The (H. B. Austin), *review* by Dr. J. E. Nichols, 251
- Meson (Neutral) : Life-time of the (Dr. A. Pais), 715
- Mesophyll Cell Walls of the Leaf : Physical Conditions of the Surface o the (Prof. Francis J. Lewis), 407
- Mesotrons at Low Energies : Energy Spectrum of (S. K. Ghosh and N. N. Das Gupta), 83
- Metabolism : Anærobic, of Spermatozoa (Dr. T. Mann), 80
- Metal Antifouling Paints (Heavy) : Anomalous Inactivation of (Prof. John E. Harris), 206
- Metal Industry : X-Ray Methods in the (Society of Czechoslovakian Mathematicians and Physicists conference on), 473, 502
- Metal Single Crystals : Effect of Alpha-Ray Bombardment on Glide in (Prof. E. N. da C. Andrade), 113
- Metal Surfaces : Lubrication of, by Fatty Acids (Dr. F. P. Bowden, J. N. Gregory and Dr. D. Tabor), 97
- Metallic Contact : Closure and Partial Separation of a (Dr. Alan Fairweather), 545
- Metallic Couples : Hydrogen Overvoltage as a Factor in the Corrosion of (L. F. LeBrocq and H. C. Cocks), 536
- Metallic Films (Thin) : Resistivity of (Prof. A. Van Itterbeek and L. De Greve), 634
- Metallography of Magnesium and its Alloys (Walter Bulian and Eberhard Fahrenhorst), translated by the Technical Staffs of F. A. Hughes and Co., Ltd., and Magnesium Elektron, Ltd., *review*, 614
- Metallurgy : National Certificates in, 138
- Metals · The Corrosion of (Institute of Physics, London and Home Counties' Branch, discussion on), 435
- Metals (Liquid) : Electrical Resistance of (Prof. K. S. Krishnan and A. B. Bhatia), 503
- Metaphysical Thinking : The Nature of (Dorothy M. Emmet), *review* by Prof. L. J. Russell, 217
- Meteoric Theory of the Origin of the Earth and Planets (Dr. O. J. Schmidt), 185
- Meteorologists : Climatology for, *review* by Prof. D. Brunt, 157
- Meter and Instrument Jewels and Pivots (G. F. Shotter), 89
- Methodology of the Social Sciences (Prof. Felix Kaufmann), *review* by Prof. David Mitrany, 278
- *Meuschenia skottowei* after a Major Injury : Survival of a specimen of (Elizabeth C. Pope), 714
- Mexico : Earthquake off Mazatlan on April 15, 201
  - (west of) : Earthquake on May 19, 201
- Mice : Mammary Cancer in (Dr. E. Boyland), 787
  - Mammary Tumours in (Members of the Staff of the National Cancer Institute, United States Public Health Service), 787
- Microbiological Assay of Riboflavin (Stanley A. Price), 171
- Microchemistry : The Teaching of Analytical Chemistry in Great Britain, with special reference to (Dr. Cecil L. Wilson), 588

crofilm and other Means of Documentary Reproduction (Association of Special Libraries and Information Bureaux conference on), 24
crographs : Electron Shadow-, of Hæmocyanin Molecules (Prof. Robley C. Williams and Dr. Ralph W. G. Wyckoff), 68
cro-organisms . Growth-Factors and Growth Inhibitors for (Dr. B. C. J. G Knight), 86
  Nature of the Gram-positive Complex in (Dr. H. Henry, Dr. M. Stacey and Dr. Ethel G Teece), 720
croscopy : Fluorescence, of Tubercle Bacilli (Dr. B. Juricic, Sr. Nicolás Vuskovic, Dr. Gastón González, Dr. Hernán Durán and Dr. Hipólito Vergara), 16
crotome Sections : Use of Hydrochloric Acid for Softening Algal Tissues for (Dr. Kathleen M Drew), 479
crowave Radiation from the Sun (G. C. Southworth), 274
ddle East Field Biology, 532
lk : The Secretion of (Prof. H. D. Kay), 159
lk Hygiene, *review*, 406
lk Supply : Bacteria in relation to the (G. H. Chalmers), third edition, *review*, 406
ller (Willet G.) Medal of the Royal Society of Canada awarded to Dr. M. E. Wilson, 271
llport Marine Laboratory : Research Work at the, 668
lne's Theory of Gravitation : The Two-body Problem in (G. J. Whitrow), 365
nd (Infant's) : Measuring the, *review* by Dr. John Cohen, 349
neral and other Resources of East and West Africa : The Contribution of Colonial Geological Survey to the Development of the (Sir Edmund Teale), 167
neral Rights : Nationalization of (Dr. L. Dudley Stamp), 667
nister of Food in Peace-time : If I were (Sir John Boyd Orr), 292
ites : Tyroglyphid, and Human Disease (Dr. G. Lapage), 427
itosis in Animal Cells : Demonstration of (Dr. W. S. Bullough), 574
oisture Meter · An Electrical (Dr. L. Hartshorn and W. Wilson), 16
olecular Giants : X-Ray Adventures among the Proteins and other (Dr. W. T. Astbury), 427
olecular Morphology of Myosin (Dr. W F. H M. Mommaerts), 631
olluscan Family Planorbidæ (Frank Collins Baker), *review* by F. Martin Duncan, 765
olten Salts : Activation Energy of Ionic Migration in (Dr. E. Heymann and H. Bloom), 479
olybdenite Crystals : Effect of Temperature on Magnetic Susceptibility of (Ajit Kumar Dutta), 240
Molybdenum Deficiency in New Zealand · A Case of (Dr. R. B. Davies), 392
Monolayers · Reactions in (Prof. E. K Rideal), 468
Moon : New Map of the (H. Percy Wilkins), 501
Morale in Industry, 91
Morality (International) : The Problems of Education in (United Nations Fellowship discussion on), 444
Morals : Politics and (Benedetto Croce), translated from the Italian by Salvatore J. Castiglione, *review* by Prof. A. D. Ritchie, 281
Morphology : Molecular, of Myosin (Dr. W. F. H. M. Mommaerts), 631
Moths : Some British (Norman Riley), *review*, 34
Motor Response from Giant Fibres in the Earthworm (Dr. W. A. H. Rushton), 109
Moulds : Antibiotics from (J. Kent and N G. Heatley), 295
Mounting Parasitic Helminths · A Medium for (Dr. Fei-pai Li and Fu-hsi Yang), 297 ; (Dr. G. Lapage), 298
Moving-Coil Instruments (G F. Tagg), 396
Moxon Medal of the Royal College of Physicians awarded to Sir Alexander Fleming, 531
Multiple Correlation by means of Stereographic Projection : Estimation of (G. F. K. Naylor), 58
Multiplication *in vitro* of Koch Bodies of *Theileria annulata* (I. Tchernomoretz), 391
Muscle : Crystallization and Identity of the Triose and Triosephosphate Dehydrogenases of (Ranwel Caputto and Dr. Malcolm Dixon), 630
  Structure of Biological Fibres and the Problem of (Dr. W. T. Astbury), 89
  (Ischæmic) : Synthesis of Adenosine Triphosphate by an Enzyme System from (Marian Bielschowsky and Prof H. N. Green), 117
  (Mammalian Striated) : Regeneration of (Prof. W. E. Le Gros Clark), 109
Muscle Fibre Membrane : Cation and Anion Permeability Constants for the (Prof. E. J Conway and P. T. Moore), 170
Muscle Fibres in relation to Carbon Dioxide Tension : Rate of Entrance of Ammonia into (Prof. E. J. Conway and P. T Moore), 270
Muscle Proteins : Heat Coagulation of (Dr. E. C. Bate-Smith and J. R. Bendall), 632
Museums : British, during the War Years, 26
  Natural History, and Research, 277
  New Zealand (Dr. W. R. B. Oliver), 165
Museums in France . Reorganization of, 641
Museums and the Community, 165
Museums and Art Galleries as a National Service, 249
Mutations in Bacterial Virus (S. E. Luria), 304
Mycobacterium tuberculosis : Activity of Helvolic Acid against (M. A. Jennings), 633
Myosin : Molecular Morphology of (Dr. W. F. H. M. Mommaerts), 631
Mysticism ; Science and, *review* by Dr. G. Lapage, 763

NAKURU, Kenya Colony : Report on the Excavations at Hyrax Hill, 1937–1938 (Mary D Leakey), 722
Narcotic Drugs and their Raw Materials · Pre-War Production and Distribution of (L. F. Atzenweiler), 361
National Certificates in Metallurgy, 138
National Defence : Science and, 29, 63, 457
National Geological Reserves in England and Wales (Report by the Geological Sub-Committee of the Nature Reserves Investigation Committee), 485
National Parks in the United States, 15
National Physical Laboratory for India, 15
National Service : Museums and Art Galleries as a, 249
Nationalization of Mineral Rights (Dr. L. Dudley Stamp), 667
Natural Colouring Matters : The Chemistry of (Dr. Fritz Mayer), translated and revised by Dr. A. H. Cook, *review* by Prof. W. Baker, 552
Natural History Museums and Research, 277
Natural Principles of Land Use (Edward H. Graham), *review* by Sir John Russell, 675
Natural and Social Sciences : The Inter-relations between the (Association of Scientific Workers discussion on), 652
Naturalist of the Highlands, *review* by Dr. F. Fraser Darling, 219
Nature for Service Men : Copies of (Lieut.-Colonel J P. Castle), 140
Nature, Nurture and Probability (Prof Gunnar Dahlberg), 539
Naval Research and Development, 472
Navigation : Astronomical Air (Squadron-Leader Ronald Hadingham), second edition, *review*, 489
Navigational Aid : A Radio, 542
Nazi Psychology : The Inferiority Complex and the Paranoid Tendency, with a Brief Reference to (Dr. William Brown), 259
Nemertine : A British Freshwater (Rachel R. Braithwaite and Evelyn B. Clayton), 237
Neomys fodiens : Mass Movement of the Water Shrew (Frances Pitt), 247
Nerve Centres in Biology and Medicine : Direct Chemical Action upon (Prof. Lena Stern), 7
Nerve Fibres : Structure, Degeneration and Repair of (J Z. Young), 132
Neuromuscular Transmission (Synaptic and) : An Electrical Hypothesis of (Prof. J. C. Eccles), 680
Neurospora : Heterokaryosis and the Mating-Type Factors in (Eva Sansome), 47
Neutral Meson : Life-time of the (Dr. A. Pais), 715
Neutron-Proton Scattering at 8·8 and 13 MeV. (Mario Bunge), 301
New Jersey : Description of a New Genus and Species of Apogonid Fish from (Henry B. Fowler), 395
New Zealand : Earthquakes registered during January, 79 ; during February and March, 264 ; during April, 544
  (east of) : Earthquake on April 19, 201
  Earthquakes in, during 1942 and 1943 (R. C Hayes), 396
  Indigenous Forests of (Prof. E. P. Stebbing), 60
  Geography in, 44
  A Case of Molybdenum Deficiency in (Dr. E. B. Davies), 392
  Soil Erosion in (Kenneth B. Cumberland), *review* by G. V. Jacks, 703
New Zealand Geographer, No. 1, 44
New Zealand Museums (Dr. W R. B Oliver), 165
New Zealand State Forest Service : Report for 1944, 60
Newfoundland Area including Labrador : A Biological and Economic Study of the Cod (*Gadus callarias* L.) in the (Dr. Harold Thompson), 213
Newton, Isaac : A Hitherto Unpublished Letter of, 193
Nickel in Eruptive Rocks : Distribution of Vanadium, Chromium, Cobalt and (Prof. L. R. Wager and R. L. Mitchell), 207
Nietzsche and Science (Mario Bunge), 263
Nigeria, its Geology and Mineral Resources (Dr. F. Dixey), 362
Nitration ? (Aromatic) : Univalent Electron Transfers in (G. A. Benford, C. A. Bunton, E. S. Halberstadt, Dr. E D. Hughes, Prof. C. K. Ingold, G. J. Minkoff and R. I. Reed), 688
Nitrogen (Active) : Radioactivity of (Dr. Kai Siegbahn and Dr. Hilding Slätis), 568
Nitrous Nitrogen from Soils on Desiccation : Losses of (Dr. M. R. Madhok and Fazal-Uddin), 49
Nobel Prize
  for Chemistry for 1944 awarded to Prof. Otto Hahn, 657
  for Chemistry for 1945 awarded to Prof. Artturi Virtanen, 714
  for Medicine for 1945 awarded jointly to Sir Alexander Fleming, Sir Howard Florey and Dr. E B. Chain, 533, 564
  for Physics for 1945 awarded to Prof. Wolfgang Pauli, 657
Nodule Bacteria (Legume) : Effective and Ineffective Strains of (Dr. H. G. Thornton), 654
Nomenclature of Animal Behaviour : Classification and (Dr. J. S. Kennedy), 754
Non-Metallic Deposits of the U.S.S.R. (S. I. Tomkeieff), 759
Non-Piezo-Electric Crystal Plates · Shear Modes in (Prof. S. Bhagavantam and J. Bhimasenachar), 23
Nova Tamm, 473
Nubian Sandstone : Geology of the (Dr. N. M. Shukri), 116
Nuclear Energy Generation in the Sun (N. R. Sen and U R. Burman), 305
Nuclear Excitation by means of X-Rays : An Attempt to obtain (Sigvard Eklund), 690
Nuclear Substances · Differentiation of (Ch. Wunderly), 750
Nucleic Acid (Solid) : Adsorption of Enzymes on (Dr. J. A. V. Butler), 781
Nucleons (Fast) : Penetration of, into Heavy Atomic Nuclei (Prof. L. Rosenfeld), 141
Number and the Atom : Time, (R. Fortescue Pickard), *review* by F. J. Garrick, 489
Nurture and Probability : Nature, (Prof. Gunnar Dahlberg), 539
Nutrition : Some British Work on (Dr. G. Lapage), 123
  The Science of (Prof. Henry C. Sherman), *review*, 318
  (Human) · Fermentation and (Dr. B. S. Platt), 87
Nutrition in Jamaica, 288
Nutritive Value of Coco-nut (Dr. J. M. Vandenbelt), 174
Nutritive Values of War-time Foods (Medical Research Council War Memorandum No 14), 330

OBSTACLES : Avoidance of, by Bats (Prof. H. Hartridge), 55
Oceanic Phytoplankton : Autotropic Flagellates as the Major Constituent of the (Dr W. R. G. Atkins), 446
Oceanographical Results of the Last Voyage of the U.S. Non-Magnetic Ship *Carnegie* (Dr. G. E. R. Deacon), 341
Oceanography : Swedish, during the War (Prof. Hans Pettersson), 180
  (Physical) : Observations and Results in (H. U. Sverdrup, F. M. Soule, J. A. Fleming and C. C. Ennis), 341
Œdema in Hamsters Infected with *Leishmania* (L. G. Goodwin), 476

Oils : Utilization of Carotene from (S. Dattatreya Rao), 234
  Influence of Vitamin E on the Utilization of Carotene from (S. Dattatreya Rao), 449
  (Different) : Comparative Vacua produced by, in a Diffusion Pump (Kamalesh Ray and Nanda Dulal Sengupta), 636
Onandaga Salt Works of the New York State, 1646–1846 (Greville Bathe), 758
Onion Eelworm : Calomel and (Dr T. Goodey), 393
Onychophora . South African (Dr. S. M. Manton), 338
Operation of the Fast Geiger-Muller Counter : Effect of the Pressure of Alcohol Vapour on the (Dr. G. D. Rochester and C. B. A. McCusker), 366
Operational Calculus Made Easy : Heaviside's (Dr. T. H. Turney), *review* by Dr. L. E. C. Hughes, 6
Operational Control of Electricity Supply Systems (W Kidd and E. M. S. McWhirter), 361
Operators in Quantum Theory (J L. B. Cooper), 54
Optical Equipment (Precision Engineering and) : Coventry Gauge and Tool Co , Ltd., Taylor, Taylor and Hobson, Ltd., and E. R. Watts and Son, Ltd., to co-operate in the development and distribution of, 387
Optically Isomeric Mepacrines · Properties of (Prof. G. F. Gause), 784
Organ Extracts · An Undialyzable Pressor Principle in (Prof. U. S. v. Euler and E Ostlund), 49
Organic Activities · The Directiveness of (Dr. E. S. Russell), *review* by Dr C H. Waddington, 731
Organic Colouring Matters Natural, *review* by Prof. W. Baker, 552
Organisms (Marine) · Chemical Composition of (S. I. Tomkeieff), 607
Oriental Culture : Indology and (Royal Asiatic Society of Bengal conference on), 687
Origin of the Earth and Planets : A Meteoric Theory of the (Dr. O J. Schmidt), 185
Origin of Uniformity, *review* by Dr. John Cohen, 515
Origin of the Solar System · New Views of the (Prof. W. H. McCrea), 466
Osler Medal for 1945 awarded to Dr. C. G. Douglas, 17
Ottawa : Agricultural Adviser at (Appointment of A. N. Duckham as), 138
Ourselves Unborn (George W. Corner), *review* by Dr. C. H. Waddington, 375
Output and the Worker (P E P Broadsheet), 91
Ovarioles of the Desert Locust (Eggs and) · Presence of Reddish Pigment in, and its Probable Phase Significance (Dr. M L. Roonwal), 19
Over-Current Relays on Medium-Voltage Circuits (A. G. Shreeve and P. J. Shipton), 305
Oxidation : Periodate, of Sugars in Neutral Phosphate Buffer (Gosta Lindstedt), 448
Oxidation and Reduction in Chemistry (Prof J Kenner), 369
Oxygen (Earth's Atmospheric) : Stability of the (Alfred Lauck Pearson), 504
Oyster-Culture in the Thames Estuary . Utilization of the Slipper-Limpet (*Crepidula fornicata*) as Food as an Aid to the Recovery of (Prof. J. H. Orton), 665

PACIFIC (Central) : Callianassidæ of the (Charles Howard Edmondson), 395
Pacific Tunas : A Systematic Study of the (H. C. Godsil and Robert D. Byers), 184
Pacific Waters : 'Palolo' Worms in (R. A. Lever), 19
Packing of Regular (Spherical) and Irregular Particles (R. L. Brown and P. G. W. Hawksley), 421 ; (H S. Leftwich), 753
Paederia foetida Linn · An Endodermal Phellogen in the Stem of (Dr. P. Maheshwari), 116
Paget (Stephen) Memorial Lecture of the Research Defence Society (Sir William Savage), 417
Paints (Heavy Metal Antifouling) : Anomalous Inactivation of (Prof. John E Harris), 206
Palæobotany : Geology and, in the U.S.S R. (W. N Edwards), 282
Palæontology : Vertebrate, in the U S.S.R. (Prof. D. M. S. Watson), 225
Palestine . Plant Pathology in, 713
Palolo Worms (Prof. Hubert Lyman Clark), 508
'Palolo' Worms in Pacific Waters (R A. Lever), 19
Paludrine, a New Anti-malarial Drug, 596
Panama · Earthquake in Chiriqui Province on June 3, 545
Paper Capacitors · Chemically Stabilized (D. A. McLean), 455
Paranoid Tendency · The Inferiority Complex and the, with a Brief Reference to Nazi Psychology (Dr. William Brown), 259
Parasites (Blood-sucking) : Hæmoglobin in (Prof. H. Munro Fox), 475
Parasitic Helminths : A Medium for Mounting (Dr. Fei-pai Li and Fu-hsi Yang), 297 ; (Dr. G. Lapage), 298
Parathyroidectomy and Lactation in the Rat (A. T. Cowie and Dr. S. J. Folley), 719
Parks · National, in the United States, 15
Parliamentary Representatives of the Universities, 168
Parthenocarpic Production of Tomato Fruits (Thomas Swarbrick), 300
Particle Shape (A H D. Markwick), 177
Particles . Packing of Regular (Spherical) and Irregular (R. L. Brown and P. G. W. Hawksley), 421 ; (H. S. Leftwich), 753
Patent Law in Britain · Reform of the (Prof. Michael Polanyi), 54 , (The Writer of the Article), 54
Pathology of the Eye (Eugene Wolff), second edition, *review*, 279
Paul (R. W.) Instrument Fund, 77
Pea Seedlings · Growth Inhibition in (E. Dorothy Brain), 397
Peace The True Foundations of, 263
Peace (War and) . Explosives in, *review* by Prof. John Read, 5
  Radar in (Sir Robert Watson-Watt), 319
  The British Radio Industry in, 713
Peace-time : If I were Minister of Food in (Sir John Boyd Orr), 292
Pedology . Tropical, *review* by Dr. A. Muir, 93
Pedology in the U.S S R. (Dr Alex Muir), 258
Peking Man · Relics of, 625
Pellagrins : Porphyrin Fluorescence in the Livers of, in relation to Ultra-Violet Light (Dr. J Gillman, Dr. T. Gillman and S. Brenner), 689
Penetration of Fast Nucleons into Heavy Atomic Nuclei (Prof. L. Rosenfeld), 141
Penicillin Chemistry of (Committee on Medical Research, Washingto and the Medical Research Council, London), 766
  Concentration of Solution of Salts of (Dr. S W. Challinor and Mr Jean MacNaughtan), 602
  Mode of Action of (Dr G. Lapage), 272
  Uses and Limitations of (Dr. G Lapage), 244
Penicillin, a Study in Co-operation, 761
Penicillin in Kala Azar (Dr. E. S. Horgan and Mohamed Hamed Satti), 2
Penicillin in Leishmania Infections (J. D. Fulton), 203
Penicillin in the Treatment of Syphilis (Major James Marshall), 769
Penicillin Action : 'Fissibactericidal' Nature of (Dr. S. W. Lee, E. J. Fole and E. R Caley), 49
Penicillin Production in Great Britain, 386
Penicillin Solutions : Stabilization of, by Phosphate (Lieut.-Colonel R. J. V Pulvertaft and Capt. John Yudkin), 82
Pennisetum Hohenackeri Hochst. Ergot on (Prof. M. J. Thirumalachar), 75
People Who Live in Glass Houses (A V.D. Orderly), 501
Peoples of India (Wm. H. Gilbert, jr.), 292
Peptides · Proteins, Amino-Acids and, as Ions and Dipolar Ions (Edwin Cohn and John T Edsall), *review* by Dr. Kenneth Bailey, 405
Periodate Oxidation of Sugars in Neutral Phosphate Buffer (Gosta Lindstedt), 448
Periodic Law : Tribute to Mendeléeff in connexion with the seventy-fift anniversary of the discovery of the (M. Pervukhim), 331
Periodic Law and its Significance for Natural Science (A. Fersman), 33
Permeability Constants · Cation and Anion, for the Muscle Fibre Membran (Prof. E. J Conway and P. T. Moore), 170
Permittivity Crystalline Aggregates . High (Prof. Willis Jackson and W Reddish), 717
Peroxidase Can the Iron in, be Replaced by Manganese ? (Prof Hug Theorell), 474
Peroxidase Reaction · Differentiation between Eosinophils and Pseudo eosinophils of Rabbits' Blood by means of a (Dr. F. Jacoby), 420
Peroxidasic Activity : Vitamin C (Dr. N Bezssonoff and Dr. Helène Leroux), 474
Personality The Physical Basis of (Prof. V H. Mottram), *review* by Dr G. Lapage, 763
Pests (Insect and Plant) Biological Control of (Dr. W R. Thompson), 27
Pharmaceutical Chemistry : Origin and Development of (H. Brindle) 138
Pharmacognosy : A Text-Book of (George Edward Trease), fourth editior revised, *review* by Dr. W. O. Howarth, 96
  A Textbook of (T. C. Denston), fourth edition, *review* by Prof. W. O Howarth, 350
Phase Transitions in Condensed Monolayers of Normal Chain Carboxyli Acids (Stina Stallberg-Stenhagen and Einar Stenhagen), 239
β-Phellandrene . A Tetrabromide of (P. A. Berry and Prof A. Killer Macbeth), 175
Phellogen · An Endodermal, in the Stem of *Paederia foetida* Linn. (Dr. P Maheshwari), 116
Phenomenology The Foundation of—Edmund Husserl and the Quest for a Rigorous Science of Philosophy (Prof. Marvin Farber), *review* by F. Ian G. Rawlins, 516
Philosophy : Cause and Sensation in, *review* by Prof. A D. Ritchie, 33
  The Foundation of Phenomenology—Edmund Hesserl and the Quest for a Rigorous Science of (Prof Marvin Farber), *review* by F Ian G. Rawlins, 516
  (Recent) Classification of, *review* by Prof. A D Ritchie, 376
Philosophy of Science : History and, 532
Phosphatase on Chromosomes (Dr J. F Danielli and D. G. Catcheside), 294
Phosphate : Stabilization of Penicillin Solutions by (Lieut -Colonel R. J V. Pulvertaft and Capt John Yudkin), 82
Phosphate Buffer (Neutral) : Periodate Oxidation of Sugars in (Gosta Lindstedt), 448
Phosphorus Deficiency of Fruit Trees (L. R. Bryant and R. Gardner), 178
Phosphorylations : Use of Dibenzylphosphoryl Chloride for (Dr. A. Deutsch and O Ferno), 604
Photo-Elastic Methods . A Photographic Method of Deriving Isoclinics in (B. Dunn), 480
Photo-Electric Fourier Transformer (Prof. Max Born, Dr. R Furth and R. W. Pringle), 756
Photographic Method of Deriving Isoclinics in Photo-Elastic Methods (B. Dunn), 480
Photography · How it Works in (Series of lectures by the Scientific and Technical Group of the Royal Photographic Society), 293
  (Air) : Recent Developments in (Wing-Comdr. H. Hamshaw Thomas), 409
  Air, in the Far East (Dr. V. J. Chapman), 604
Photopolymerization (Vinyl Acetate) : Propagation and Termination Coefficients for (G M. Burnett and Prof. H. W. Melville), 661
Photosynthesis and related Processes (Eugene I. Rabinowitch), Vol. I, Chemistry of Photosynthesis, Chemosynthesis and related Processes in Vitro and in Vivo, *review* by Prof. F. J Lewis, 487
Physical Basis of Personality (Prof. V. H. Mottram), *review* by Dr. G. Lapage, 763
Physical Conditions of the Surface of the Mesophyll Cell Walls of the Leaf (Prof Francis J. Lewis), 407
Physical Constants of Substances · Card File of, 775
Physical Theory of the Solar Corona (Dr. A. Hunter), 649
Physics : Contemporary, in the U.S.S R. (Prof E. N. da C. Andrade), 223
  Theoretical, in the U.S S R (Prof. M. Born), 325
Physics and Astrophysics at the Imperial College (Prof Herbert Dingle), 562
Physics, Chemistry and Biology in India : Research Fellowships in, 107
Physiologie en Belgique : Léon Fredericq et les débuts de la (Prof. Marcel Florkin), *review* by Prof C Lovatt Evans, 764
Physiologist : A Great, *review* by Prof. C. Lovatt Evans, 764
Physiology of Farm Animals (Dr. F. H. A Marshall and E. T. Halnan), third edition, *review* by Dr John Hammond, 377
Physiology in the U.S.S.R. (Prof. E. D. Adrian), 222
Physiology of Vision : Research in the U.S.S R. on the, 579
Phytopathological Uses of the new Insecticide D.D.T. (H. Martin and R. L. Wain), 168
Phytoplankton · Conditions for the Vernal Increase in the, and a Supposed Lag in the Process (Dr. W. R. G. Atkins), 599
  (Oceanic) : Autotropic Flagellates as the Major Constituent of the (Dr W. R. G. Atkins), 446

- erce (Lorne) Medal of the Royal Society of Canada awarded to l'Abbé Felix Antoine Savard, 271
- ezo-Electric Oscillation of a Quartz Crystal : Harmonics in the (L. C. Tsien and H. C. Chu), 424
- g-keeping : Science and, *review* by Dr. John Hammond, 434
- g-raising Industry The British (Dr. J. E. Nichols), 454
- gmentation : Cervico-Facial (Melanosis of Riehl-Poikiloderma) (Dr. Georges Garnier), translated by Major James Marshall, 163
- gments and Chromatophore Reactions of *Polycelis nigra* and *Planaria lugubris* (Capt. J. L. Cloudsley-Thompson), 294
- gs (V. C. Fishwick), revised edition, *review* by Dr John Hammond, 434
- vots (Jewels and) : Meter and Instrument (G F Shotter), 89
- *anaria lugubris* (*Polycelis nigra* and) . Pigments and Chromatophore Reactions of (Capt. J. L. Cloudsley-Thompson), 294
- lanets · A New Theory of the Origin of the (Dr. Hannes Alfvén), 378
  - (Earth and) : A Meteoric Theory of the Origin of the (Dr. O J. Schmidt), 185
- lanned State : Science and the (John R. Baker), *review*, 614
- lanning . Historical Background of, 166
- lanorbidæ · The Molluscan Family (Frank Collins Baker), *review* by F. Martin Duncan, 765
- Plant Life and Solar Energy, *review* by Prof. F. J. Lewis, 487
- Plant Pathologists in Great Britain The Recruitment and Training of (Association of Applied Biologists), 724
- Plant Pathology in Palestine, 713
- Plant Pests (Insect and) : Biological Control of (Dr. W. R Thompson), 271
- Plant Science · Plants and, in Latin America (edited by Frans Verdoorn), *review*, 676
- Plant Species · Effect of some Arylcarbamic Esters and related Compounds upon Cereals and other (Dr. W. G. Templeman and Dr W. A. Sexton), 630
- Plant Studies in Syria (Prof Zohary), 246
- Plants : Hay-fever (Roger P. Wodehouse), *review* by Dr. H. Godwin, 317
  - (Familiar English) A Flora of, *review* by Prof. F. J. Lewis, 461
- Plants in Acid Soils : Determination of Factors Injurious to (Prof. T. Wallace, E. J. Hewitt and D. J D Nicholas), 778
- Plants and Plant Science in Latin America (edited by Frans Verdoorn), *review*, 676
- Plato and the Academy · Aristotle's Criticism of (Harold Cherniss), Vol. I, *review* by Prof. A. E. Taylor, 647
- Platonism : Aristotle's Criticism of, *review* by Prof. A. E. Taylor, 647
- Pleistocene Period, its Climate, Chronology and Faunal Successions (Dr. Frederick E. Zeuner), *review* by Sir George Simpson, 730
- Plenty : Towards a World of (United Nations Information Organisation), 727
- Plywood : Conditioning of, 139
- Plywood Tea Chests (Indian) : The Testing of (V. D. Limaye), 668
- Polarity : Process and (Prof. Wilmon Henry Sheldon), *review* by Prof. A. D. Ritchie, 376
- Politics . Poverty and, in Central Europe, *review* by Capt. Maurice Bruce, 551
- Politics and Morals (Benedetto Croce), translated from the Italian by Salvatore J Castiglione, *review* by Prof. A. D. Ritchie, 281
- Pollenanalytische, stratigraphische und geochronologische Untersuchungen aus dem Faulenseemoos bei Spiez (Max Welton), 383
- *Polycelis nigra* and *Planaria lugubris* : Pigments and Chromatophore Reactions of (Capt. J. L. Cloudsley-Thompson), 294
- Polymerization : Friedel-Crafts Catalysts and (Department of Chemistry, University of Manchester conference on), 232, 638
  - Low Temperature (Dr. A. G. Evans and Prof. M. Polanyi), 638
- Polymerization of Vinyl Compounds : The Mechanism of (Prof. H. W. Melville), 639
- Polymorphonuclear Leucocyte (Human) : Granules of the (Major J. F A McManus), 173
- 'Polyporin' Anti-bacterial Action of, against Typhoid, Cholera, Dysentery and *B. coli* (Prof. S R. Bose), 171
- Polysaccharide from *Gigartina stellata*—the Isolation of Crystalline 2 : 6-Dimethyl-β-*d*-Galactopyranose from the Methylated Polysaccharide (Eric T. Dewar and Dr E. G. V Percival), 633
- Polysaccharides : Application of New Methods of End-Group Determination to Structural Problems in the (F. Brown, Sonia Dunstan, T. G. Halsall, Prof. E L. Hirst and J. K N. Jones), 785
- Popliteal Facet in Men who Habitually Squat (Prof. M. A. Shah), 237
- Porphyrin Fluorescence in the Livers of Pellagrins in relation to Ultra-Violet Light (Dr. J. Gillman, Dr. T. Gillman and S Brenner), 689
- Portuguese Timor : Anthropology of, *review* by Prof. A. R. Radcliffe-Brown, 129
- Post-Glacial Development of Forests · The Hazel Period in the (Prof. Felix Rawitscher), 302
- Postgraduate Training : Awards for (National Research Council of Canada), 201
- Post-Jurassic Intrusions of the Aldan Region, Eastern Siberia (Y. A. Bilibin), 178
- Post-War Educational Reconstruction in the United Nations (edited by Prof. I. L. Kandel), *review*, 318
- Post-War European Broadcasting (Radio Industry Council report on), 250
- Post-War Forest Policy in India (Prof. E. P. Stebbing), 286
- Post-War Planning for Scientific Research in Canada (Dr C J McKenzie), 500
- Post-War World Organisation : The Place of Science and International Scientific Co-operation in (Dr Joseph Needham), 558
- Potassium Dihydrogen Phosphate : Laue Photographs of Sub-crystalline Regions in 'Hybrid' Crystals of (Dr. A. R. Ubbelohde and Miss I. Woodward), 20
- Potato Foliage Frost Injury Simulating Virus Disease Symptoms on (Robert McKay and Dr Phyllis E. M Clinch), 449
- Potatoes (Seed) : Control of Dry Rot of, by Dusting (Dr C. E. Foister, Dr. A. R. Wilson and Dr. A. E. W Boyd), 394
- Potential and Spherical Harmonics . The Theory of (Wolfgang J. Sternberg and Prof. Turner L. Smith), *review* by J H Pearce, 5
- Potentials (Very Low) Visible Glow Discharge at (Dr A. Sommer), 242
- Poverty and Politics in Central Europe, *review* by Capt Maurice Bruce, 551
- Powderpost Beetles : Protection of Timber against, 16
- Prague, German University in · Closing of the, 502
- Pre-War Production and Distribution of Narcotic Drugs and their Raw Materials (L. F. Atzenweiler), 361
- Prehistory . Pitfalls in (Prof. C. van Riet Lowe), 777
- Pressor Principle in Organ Extracts : An Undialysable (Prof. E. S. v. Euler and E. Ostlund), 49
- Pressor Substance in Animal Organ Extracts · A Sympathomometic (Prof. U. S. v. Euler), 18
- Pressure of Alcohol Vapour on the Operation of the Fast Geiger-Muller Counter : Effect of the (Dr. G. D Rochester and C. B. A. McCusker), 366
- Pressure on Thermal Diffusion in Gases . Effect of (K. E. Grew), 267
- Pressure Units (E Denne), 146
- Probability : Nature, Nurture and (Prof. Gunnar Dahlberg), 539
- Problema Racial en las Américas : El Indoamericanismo y el (Prof. Dr. Alejandro Lipschutz), segunda edicion, review by Prof. A. Radcliffe-Brown, 158
- Process and Polarity (Prof. Wilmon Henry Sheldon), *review* by Prof. A D. Ritchie, 376
- Projection (1944) Controlled (arranged by John C. Raven), *review* by Dr. John Cohen, 701
- Projection (Stereographic) : Estimation of Multiple Correlation by means of (G. F. K. Naylor), 58
- Projector · A New Film-Strip (Dufay-Chromex, Ltd.), 264
- Propagation and Termination Coefficients for Vinyl Acetate Photopolymerization (G M. Burnett and Prof. H. W. Melville), 661
- Protactinium · Anodic Deposit of (M Haissinsky), 423
- Proteins, Amino-Acids and Peptides as Ions and Dipolar Ions (Edwin J Cohn and John T. Edsall), *review* by Dr Kenneth Bailey, 405
- Proteins and Foods : The Amino Acid Composition of (Dr. Richard J. Block and Diana Bolling), *review*, 33
- Proteins and other Molecular Giants · X-Ray Adventures among the (Dr. W. T Astbury), 427
- Proteolytic Enzymes · Congo Red Fibrin Powder for Experiments on (D. G Duncan and Dr. H. Zwarenstein), 112
- Pseudo-eosinophils of Rabbits' Blood · Differentiation between Eosinophils and, by means of a Peroxidase Reaction (Dr. F. Jacoby), 420
- Psychiatry : Social, *review* by Dr. J. Leycester King, 279
- Psychology of War, *review* by Dr. William Brown, 314
- Psychology (Nazi) The Inferiority Complex and the Paranoid Tendency, with a Brief Reference to (Dr. William Brown), 259
- Public Health and Its Debt to Experimental Medical Research (Sir William Savage), 417
- Pump (Diffusion) : Comparative Vacua Produced by Different Oils in a (Kamalesh Ray and Nanda Dulal Sengupta), 636
- Pumps (Diffusion) . Performance of (Dr. K C. D. Hickman), 635
- Pus : Cell Contents of (Dr. F Duran-Jorda), 110

- QUALITY Control in Business Production and Administration (William B. Rice), 330
- Quantum Electrodynamics (Prof. P. A M Dirac), 704 ; (Prof. Max Born), 705
- Quantum Theory : Operators in (J. L B. Cooper), 54
- Quartz Crystal : Harmonics in the Piezo-Electric Oscillation of a (L. C. Tsien and H. C. Chu), 424
- Quaternion Centenary Celebration, 361
- Quinine Degradation Products Loss of Antimalarial Properties in (P. B. Marshall), 505
- Quinol Molecules : Hydrogen Bond Linking of (D. E. Palin and H. M. Powell), 334

- RABBITS' Blood : Differentiation between Eosinophils and Pseudo-eosinophils of, by means of a Peroxidase Reaction (Dr F. Jacoby), 420
- Race Problem in South America, *review* by Prof. A. R Radcliffe-Brown, 158
- Rachitic Rats Effect of Restriction of Food Intake upon the Incisor Teeth of (Prof J. T Irving), 664
- Radar . Detection of Birds by (David Lack and G C Varley), 446 ; (Lieut H A. C. McKay), 629
- Radar—a Report on Science at War, 444
- Radar in War and in Peace (Sir Robert Watson-Watt), 319
- Radio Industry : British, in War and Peace, 713
- Radio Navigational Aid, 542
- Radio Waves from the Sun, 273
- Radioactivity of Active Nitrogen (Dr. Kai Siegbahn and Dr. Hilding Slätis), 568
- R.A F. Aerial Survey in Peace-time, 2
- Raman Effect in Rocksalt (Prof. Max Born and Mary Bradburn), 567
- Raman and Infra-red Spectra of Rock-salt (Dr. R. S Krishnan), 267
- Rape (*Brassica napus* L.) Leaf · Occurrence of Hexadecatrienoic Acid in the Glycerides of (Dr. F. B. Shorland), 269
- Rat : Parathyroidectomy and Lactation in the (A. T. Cowie and Dr. S. J. Folley), 719
- Rat Fed with 2-Acetyl-amino-fluorene · Glioma in a (Dr. E. Vazquez Lopez), 296
- Rats (Rachitic) · Effect of Restriction of Food Intake upon the Incisor Teeth of (Prof. J. T. Irving), 664
- Reactions at Interfaces and their Significance in Biology (Dr J F. Danielli), 468
- Reactions in Monolayers (Prof. E. K. Rideal), 468
- Reactions (Enzyme and Immune) : Comparison of, *review* by Dr. P. Johnson, 517
- Reconstruction Research in relation to (Sir John Anderson), 660
  - Science and (Sir John Anderson), 711, 733
- Recording · Automatic Control and, in Chemical and other Processes (Institution of Chemical Engineers, the Institute of Physics, and the Chemical Engineering Group of the Society of Chemical Industry conference on), 45, 723
- Red Corpuscles of the Hen Life-Cycle of the (Prof. G Hevesy and J. Ottesen), 534
- Redbrick and These Vital Days (Bruce Truscot), *review* by R. Brightman, 432
- Reddish Pigment in Eggs and Ovarioles of the Desert Locust, and its Probable Phase Significance : Presence of (Dr. M. L. Roonwal), 19

Reduction : Oxidation and, in Chemistry (Prof. J. Kenner), 369
Reflexes (Conditioned) : Research in the U.S.S.R on, 455
Regeneration of Mammalian Striated Muscle (Prof. W. E. Le Gros Clark), 109
Register : The Annual, for the Year 1944 (edited by Dr. M. Epstein), *review*, 489
Regression . Spontaneous, of Histologically Malignant Tumours Induced in Rabbits by 9 : 10-Dimethyl-1 : 2-Benzanthracene (Stephan Beck), 238
Rehabilitation and Land Use : Demobilization, 429
Relativistic Cosmology : Clock-Regraduations and (Dr. T. J Willmore), 748
  A New Approach to (Prof. L. Infeld), 114
Relativity (Kinematical) : Cosmic Rays and (Prof. J. B S. Haldane), 266 ; (Prof. Herbert Dingle), 389, 748 ; (Prof. E. A. Milne), 747
Religion and Science (Prof. H. Dingle), 232
Religious Instruction in Schools, 626
Reorganization of Museums in France, 641
Repair of Nerve Fibres · Structure, Degeneration and (J. Z. Young), 132
Repeating Compasses (W. E. May), 593
Reproduction (Documentary) . Microfilm and other Means of (Association of Special Libraries and Information Bureaux conference on), 24
Reproduction Cycle : A Sexual, of *Trypanosoma congolense* Broden (R. N. T -W.-Fiennes), 390
Research : Chemical, at Leeds, 659
  Recent Chemical, in the U.S.S.R., 697
  Embryology of Angiosperms as a Field for (Dr. P. Maheshwari), 354
  Grants for (Research Corporation of New York), 744
  Health, in Industry (Dr. G. Lapage), 148
  Industrial, in Great Britain, 711
  Methods of (Prof. D. D. Kanga), 777
  Natural History Museums and, 277
  Conditions for the Promotion of, 125
  (Scientific) : Film as an Instrument of (Derek Stewart), 426
  (Scientific) : Freedom for (Lord Brabazon of Tara), 746
  Scientific, in India and the British Colonies, 758
Research 1944–45 : Colonial, 509
Research in Animal Breeding and Genetics in Great Britain, 231
Research in Britain on Atomic Energy, 531
Research within the British Commonwealth : Society of Visiting Scientists meetings to discuss the organisation of, 660
Research in Canada (Post-War Scientific) : Planning for (Dr. C. J. McKenzie), 500
Research in relation to Reconstruction (Sir John Anderson), 660
Research in the U.S S.R. on Conditioned Reflexes, 455
Research in the U.S.S.R. on the Physiology of Vision, 579
Research in the United States : A Plan for, 130
Research and Development in the British Colonies, 509
Research and Development in the United States, 360
Research and Development : Naval, 472
Research Associations in Britain : Government Support for (Herbert Morrison), 597
Research Bill : The Industrial, 625
Research Expedition : Danish, 565
Research Fellowships in Chemistry, Physics and Biology in India, 107
Research Fellowships in Engineering and Science, 659
Research Libraries . University and (Library Association conference on), 417
Research Libraries and Information Bureaux : The Planning and Equipment of (E. J. Carter), 605, 606
Research Work at the Millport Marine Laboratory, 668
Resistance : Electrical, of Liquid Metals (Prof. K. S. Krishnan and A. B. Bhatia), 503
Resistivity of Thin Metallic Films (Prof. A. Van Itterbeek and L. De Greve), 634
Resources of East and West Africa (Mineral and other) · The Contribution of Colonial Geological Survey to the Development of the (Sir Edmund Teale), 167
Respiration of Spermatozoa in Egg-Yolk Medium (J. Tošić and Dr. Arthur Walton), 507
Respiratory, Vasomotor and Cardio-Regulatory Centres : Influence of Blood Pressure and Blood Flow on the Activity of the (Prof. C. Heymans), 750
Restriction of Food Intake upon the Incisor Teeth of Rachitic Rats : Effect of (Prof. J. T. Irving), 664
Rh and Blood Transfusion, 625
Rh Antibody ('Incomplete' or 'Blocking') : Further Observations on the (R. R A. Coombs and Dr. R. R. Race), 233
Rheological Properties of Suspensions . General (British Rheologists' Club and the Manchester Section of the Oil and Colour Chemists' Association discussion on), 745
Riboflavin : Microbiological Assay of (Stanley A. Price), 171
Rigour : In Search of, *review* by F. Ian G. Rawlins, 516
Rockefeller Medical Fellowships to be resumed by the Medical Research Council, 17
Rocks (Eruptive) : Distribution of Vanadium, Chromium, Cobalt and Nickel in (Prof. L. R. Wager and R. L. Mitchell), 207
Rocksalt : The Raman Effect in (Prof. Max Born and Mary Bradburn), 567
  Raman and Infra-red Spectra of (Dr. R. S. Krishnan), 267
Root Distribution of Fruit Trees (E. L Proebsting), 395
Roots : A Factor in Clover Nodule Formation associated with the Volume of the Medium Occupied by the (Dr. P. S. Nutman), 20
Rothamsted : Some Aspects of the Work at (Dr. W. G. Ogg), 211
Royal College of Chemistry (Dr. E. Frankland Armstrong), 524
Royal Medals of the Royal Society awarded to Prof. J. D. Bernal and Dr. E. J. Salisbury, 596, 694
Rubber · Physical and Chemical Breakdown of (Midland Section of the Institution of the Rubber Industry symposium on), 9
  Synthetic, from Alcohol (Anselm Talalay and Michael Magat), *review* by Dr. W. J. S. Naunton, 251
Rubber and GR-S (Natural) : The Behaviour of, under Repeated Stress Cycles (Dr. D. Parkinson and J. L. Bloxham), 11
Rubber Cracking : The Mechanism of (E. F. Powell and V. E. Gough), 11
Rupture (Brittle) · Mechanism of (J. B. Murgatroyd and R. F. Sykes), 716
Rural Pursuits of President Jefferson, *review* by Dr. E. J. Salisbury, 128
Rye-Grass · Blind Seed Disease of (Malcolm Wilson, Mary Noble and Elizabeth G. Gray), 178

SALMON in Irish Rivers : Previously Spawned (Arthur E. J. Went), 1
Salt Solutions (Inorganic) : Cytological Reactions Induced by (Alb Levan), 751
Salts (Molten) . Activation Energy of Ionic Migration in (Dr. E . Heyma and H. Bloom), 479
Sampling : Economy in (G. A Barnard), 208
  Inverse Binomial (Dr. R. A. M. Case), 115
San Diego, California : Annotated List of the Marine Algæ and Mari Grasses of (E. Yale Dowsen), 533
Scales : Logarithmic (F. Campbell Rose), 268
Scaliness of Wool Fibres (J. Menkart and Prof J. B. Speakman), 143
Scapegoat in Modern Europe (Royal Anthropological Institute and th Social Psychology Section of the British Psychological Society di cussion on), 380
Scattering · Neutron-Proton, at 8·8 and 13 MeV. (Mario Bunge), 301
School Mathematics : A New Approach to, 330
Schools : Religious Instruction in, 626
  (Primary) : The Place of Science in (H. Benfield), 56
  (Secondary) : The Teaching of Science in (E. J. Rose), 56
Science · The Application of, to Industry in Australia (Sir David Rivett), 47
  The Film in (Scientific Film Association conference on), 79, 426
  Food, *review* by Dr. T. Moran, 220
  History and Philosophy of, 532
  Information Service as an Essential in the Progress of (Prof. J. D Bernal), 605
  Limitations of, 777
  The Mission of (Sir Henry Dale), 677
  Nietzsche and (Mario Bunge), 263
  Team Work in, 581
  The Unity of, 652
  World Co-operation in (J. G. Crowther), 556
Science, the Endless Frontier (Dr. Vannevar Bush), 125, 130
Science Controlled by the Material Wants of Man ?: Is the Progress o (Dr. F. Sherwood Taylor), 166
Science Co-operation Service : An International, 401
Science in Adult Education (C. V. Bellamy), 57
Science and Education (Association of Scientific Workers, Leeds Branch conference on), 56
Science and Education in India, 291
Science and Ethics (Prof John A. Ryle), 619, 623
Science of Explosives (Prof. Martin Meyer), *review* by Prof. John Read, 5
Science and Foreign Policy (G. Fielding Elliot), 63
Science and the Idea of God (William Ernest Hocking), *review*, 281
Science and International Scientific Co-operation in Post-War World Organisation : The Place of (Dr. Joseph Needham), 558
Science in Kweichow and Kuangsi (Dr. Joseph Needham), 496
Science and Mysticism, *review* by Dr. G Lapage, 763
Science and National Defence, 29, 63, 457
Science of Nutrition (Prof. Henry C. Sherman), *review*, 318
Science of Philosophy : The Foundation of Phenomenology—Edmund Husserl and the Quest for a Rigorous (Prof. Marvin Farber), *review* by F. Ian G. Rawlins, 516
Science and Pig-keeping, *review* by Dr. John Hammond, 434
Science and the Planned State (John R. Baker), *review*, 614
Science in Primary Schools : The Place of (H. Benfield), 56
Science and Reconstruction (Sir John Anderson), 711, 733
Science and Religion (Prof. H. Dingle), 232
Science in Secondary Schools : The Teaching of (E. J. Rose), 56
Science and the United Nations (Dr. Julian Huxley), 553
Science in the United Nations Organisation, 625
Science and the University (Prof. S Brodetsky), 57
Science in the U S.S R :—Physiology (Prof. E D Adrian), 222 ; Contemporary Physics (Prof. E. N. da C Andrade), 223 ; Archæology and Anthropology (Prof. V. Gordon Childe), 224 ; Vertebrate Palæontology (Prof. D. M. S. Watson), 225 ; Medicine (Prof. Arnold Sorsby), 226 ; Agrochemistry (Dr. E. M. Crowther), 227 ; Evolutionary Biology and related Subjects (Dr. Julian Huxley), 254, *errata*, 293 ; Crystallography (Dr. W. A Wooster), 256 , Pedology (Dr. Alex Muir), 258 ; Geology and Palæobotany (W. N. Edwards), 282 ; Physical Chemistry (Prof. C. N. Hinshelwood), 283 ; Surface Chemistry (Prof. N. K. Adam), 284 , Astronomy and Terrestrial Magnetism (Sir Harold Spencer Jones), 324 ; Theoretical Physics (Prof. M. Born), 325
Science and War, 659
Science at War : Radar—a Report of, 444
Science (Engineering and) . Research Fellowships in, 659
Science Film in Education (Miss Dorothy Grayson), 426
Science Magazine . A new series of programmes by the B B.C., 140
Sciences (Natural and Social) : The Inter-relations between the (Association of Scientific Workers discussion on), 652
Sciences (Social) : Methodology of the (Prof. Felix Kaufmann), *review* by Prof David Mitrany, 278
Scientific Affairs in Europe, 576
Scientific Civil Service, 643
Scientific Commission . A Permanent International (Prof. J. D. Bernal), 557
Scientific Co-operation with Czechoslovakia, 416
Scientific Co-operation in Post-War World Organisation (International) : The Place of Science and (Dr. Joseph Needham), 558
Scientific Film . Teaching by means of the (J. Maddison), 57
Scientific Film Needs in Technical Training (W. F. Andrews), 426
Scientific Freedom : Atomic Energy and, 564
Scientific Instrument Industry : Man-Power and Training in the, 154
Scientific Intercourse . Freedom of, 215
Scientific Man-power and Resources : Committee on, 686
Scientific Rehabilitation in Europe, 472
Scientific Research : Film as an Instrument of (Derek Stewart), 426
  Freedom for (Lord Brabazon of Tara), 746
Scientific Research in Canada : Post-War Planning for (Dr. C. J. McKenzie), 500
Scientific Research in India : Fellowships for, 107
Scientific Research in India and the British Colonies, 758
Scientific Service in Britain : A State, 643
Scientific Theory of Culture, and other Essays (Bronislaw Malinowski), *review* by Dr. C. S. Myers, 218
Scientist and the Economic and Social Council (Guy B. Gresford), 625

——cientists : Lessons of the War for (Prof. J. D. Bernal), 659
(Government) : A New Deal for, 644
ea-Level in Glacial Times : Lowering of (A. Farrington), 396
ecretion of Milk (Prof. H. D. Kay), 159
eeds (Bearded Iris) : Germination of (L. F. Randolph and L. G. Cox), 395
eismology (Perry Byerly), *review* by E. Tillotson, 95
ensation : Cause and, in Philosophy, *review* by Prof. A. D. Ritchie, 33
ense Organs (Human) : Conditioned Excitors and (Prof. Krikor Kekcheyev), 573
eparation (Partial) : Closure and, of a Metallic Contact (Dr. Alan Fairweather), 545
Sera : Anti-*Hr* (Dr. Philip Levine), 418
Serological Reactions : The Specificity of (Dr. Karl Landsteiner), revised edition, *review* by Capt. J. A. R. Miles, 348
Serum (Human) : Enhancement of the Action of Immune Hæm-Agglutinins by (K. E. Boorman, B. E. Dodd and Dr. W. T. J. Morgan), 663
Serum Albumin (Human) : Heterogeneity of (H. Hoch and C. J. O. R. Morris), 234
Serum Proteins in the Ultracentrifuge (J. St. L. Philpot), 247
Serum and Serum Fractions : Ultracentrifugal Studies on (Dr. Kai O. Pedersen), 247
Service Men : Copies of *Nature* for (Lieut.-Colonel J. P. Castle), 140
Sewage Filters (Percolating) : Control by D.D.T. of Flies Breeding in (T. G. Tomlinson), 478
Sex Education—Aims, Possibilities and Plans (Cyril Bibby), 412, 438
Sexual Differentiation of the Gonad and the Sexualization of the Germ Cells in Teleosts (Prof. Umberto D'Ancona), 603
Sexual Reproduction Cycle of *Trypanosoma congolense* Broden (R. N. T.-W.-Fiennes), 390
Sexualization of the Germ Cells in Teleosts : Sexual Differentiation of the Gonad and the (Prof. Umberto D'Ancona), 603
Shadow-Micrographs : Electron, of Hæmocyanin Molecules (Prof. Robley C. Williams and Dr. Ralph W. G. Wyckoff), 68
Shear : Viscosity of Ordinary Liquids at High Rates of (L. Grunberg and Dr. A. H. Nissan), 241
Shear Modes in Non-Piezo-Electric Crystal Plates (Prof. S. Bhagavantam and J. Bhimasenachar), 23
Sheep (J. F. H. Thomas), *review* by Dr. J. E. Nichols, 251
Shirley Fellowship Awards, 200, 686
Shrubs as Food for Cattle : Use of Trees and, 151
Sight without Glasses (Good) : The Bates Method for (Dr. William H. Bates), *review*, 281
Silicic Acid Jellies for Bacteriological Purposes : Preparation of (Bjorn Ingelman and Ingvar Jullander), 572
Size : An Illusion of (Prof. H. Hartridge), 118, 636 ; (J. Phelps), 269 ; (Robert Weil), 636
Skin Burns by Hot Gases : Production of (O. M. Lidwell), 298
Sky : The Night, in August, 108 ; in September, 232 ; in October, 387 ; in November, 502 ; in December, 660 ; in January, 777
(Night) : Infra-Red Spectrum of the (R. Herman, L. Herman and J. Gauzit), 114
Slide-Culture Technique : A Modification of (P. H. B. Talbot), 391
Slipper-Limpet (*Crepidula fornicata*) as Food as an Aid to the Recovery of Oyster-Culture in the Thames Estuary : Utilization of the (Prof. J. H. Orton), 665
Smith (J Lawrence) Medal of the United States National Academy of Sciences for 1945 awarded to Stuart H. Perry, 575
Smith (Theobald) Gold Medal of the American Academy of Tropical Medicine awarded to Dr. C. M. Wenyon, 473
Smithsonian Publications Available for Distribution : Classified List of (Helen Munroe), 362
Soap : Efficacy of D.D.T. in (G. A. Campbell, F. C. Hymas and Dr T. F. West), 749
Social Learning and Imitation (Neal E. Miller and John Dollard), *review* by Dr. John Cohen, 515
Social Psychiatry, *review* by Dr. J. Leycester King, 279
Social Sciences : Methodology of the (Prof. Felix Kaufmann), *review* by Prof. David Mitrany, 278
Social Security for Chemists (British Association for Chemists, London Section, open meeting on), 331
Social Studies : Method in, *review* by Prof. David Mitrany, 278
Social and Economic Fields : International Co-operation in, 231
Sodium Doublet Lines : Splitting of the (Prof. N. R. Tawde, B. S. Patil and G. K. Mehta), 662
Sodium Fluoride : Formation of an Addition Compound of Calcium Silicate and (Cyrill Brosset), 451
Soil (Very Acid) : Accumulation of Sugars in Barley Seedlings on (T. W. Barnes), 692
Soil Erosion in New Zealand (Kenneth B. Cumberland), *review* by G. V. Jacks, 703
Soils : Losses of Nitrous Nitrogen from, on Desiccation (Dr. M. R. Madhok and Fazal-Uddin), 49
Soils of Equatorial Regions with special reference to the Netherlands East Indies (Prof. Dr. E. C. Jul. Mohr), translated from the Nederlandsch by Robert L. Pendleton, *review* by Dr. A. Muir, 93
Soils (Acid) : Determination of Factors Injurious to Plants in (Prof. T. Wallace, E. J. Hewitt and D. J. D. Nicholas), 778
Solar Activity : A Forecast of (Dr. W. Gleissberg), 539
Solar Corona : A Physical Theory of the (Dr. A. Hunter), 649
Solar Cycle : Behaviour of Ultra-Violet and Daylight Rays in the (Dr. J. R. Ashworth), 115
Solar Energy : Plant Life and, *review* by Prof. F. J. Lewis, 487
Solar Radiation : Departure of Long-Wave, from Black-Body Intensity (Sir Edward Appleton); 534
Solar System : A New Cosmogony of the (Dr. A. Hunter), 378
New Views of the Origin of the (Prof. W. H. McCrea), 466
Solid Substances : Spectral Analysis of (Dr. J. Eeckhout), 175
Solids (Extended) : Measurement of Ultrasonic Velocities in (R. Parshad), 637
Solutes (Two) : Chromatography of (Dr. E. Glückauf), 205, 571 ; (A. C. Offord and Dr. J. Weiss), 570
Solution of Alkali Halides in Borax and B_2O_3 Glass Systems : X-Ray Study of the (S. K. Majumdar, B. K. Banerjee and K. Banerjee), 423
Solutions : Time Dependence of Interfacial Tension and Density in (Prof. George Antonoff), 301
Solutions of Salts of Penicillin : Concentration of (Dr. S. W. Challinor and Mrs. Jean MacNaughtan), 602
Solvent for Melanin : A Neutral (A. J. Lea), 478
Space-Group of Co_2-Al_9 : Unit Cell and (Audrey M. B. Parker), 783
Spain : Earthquakes registered during January, 79 ; during February, 79 ; during March, 264 ; during April, 544
Special Librarian in Industry : Some Problems of the (E. N. Simon), 605, 606
Specificity of Serological Reactions (Dr. Karl Landsteiner), revised edition, *review* by Capt. J. A. R. Miles, 348
Spectra of Coals : Infra-Red (C. G. Cannon and Dr. G. B. B. M. Sutherland), 240
Spectra of Diatomic Oxides by the Method of Exploded Wire (B. Rosen), 570
Spectral Analysis of Solid Substances (Dr. J. Eeckhout), 175
Spectral Structure of the Inert Gases (Prof. Bengt Edlén), 445
Spectroscopy : Infra-red (R. Bowling Barnes, Robert C. Gore, Urner Liddel and Van Zandt Williams), *review* by Dr. H. W. Thompson, 65
Spectrum : Energy, of Mesotrons at Low Energies (S. K. Ghosh and N. N. Das Gupta), 83
Infra-Red, of the Night Sky (R. Herman, L. Herman and J. Gauzit), 114
Spectrum of Iodine : Emission Bands of the Fluctuation Type in the (Prof. R. K. Asundi and P. Venkateswarlu), 452
Speech : Is Human, Good Enough ? (Sir Richard Paget), 209
Spermatozoa : Anærobic Metabolism of (Dr. T. Mann), 80
Spermatozoa in Egg-Yolk Medium : Respiration of (J. Tošić and Dr. Arthur Walton), 507
Spherical Harmonics : The Theory of Potential and (Wolfgang J. Sternberg and Prof. Turner L. Smith), *review* by J. H. Pearce, 5
Spicules on the Sun (Dr. Walter O. Roberts), 362
Spider : The Black Widow, *review* by T. H. Savory, 253
Splitting of the Sodium Doublet Lines (Prof. N. R. Tawde, B. S. Patil and G. K. Mehta), 662
Spraying : Control of Weeds by, 330
Squat : The Popliteal Facet in Men who Habitually (Prof. M. A. Shah), 237
Squirrels (Grey) : Inheritance of Melanism in (Monica Shorten), 46
Stability of the Earth's Atmospheric Oxygen (Alfred Lauck Parson), 504
Stabilization of Penicillin Solutions by Phosphate (Lieut.-Colonel R. J. V. Pulvertaft and Capt. John Yudkin), 82
Staphylococcus aureus Infections : Effect of Tissue Extracts in controlling (Dr. Leo G. Nutini and Sr. Eva Maria Lynch), 419
Starch in Cultures of Capsulated Yeasts (Extracellular) : Production of (Dr. M. Aschner, J. Mager and Dr. J. Leibowitz), 295
Starch Storage in the Barley Grain : Some Factors concerned in the Process of (H. K. Archbold), 70
Stars for Eros (Southern Comparison) : Re-Observation of the Magnitudes of the (R. H. Stoy and A. Menzies), 179
State (Modern) : Men of Science in the (Lord Winster), 231
Statistics in the (Lord Woolton), 686
State (Planned) : Science and the (John R. Baker), *review*, 614
State Scientific Service in Britain, 643
Statesman's Year Book for 1945 (edited by Dr. M. Epstein), *review*, 614
Static : Cosmic (Grote Reber), 396
Statistical Methods : Application of, to Mechanical Test Results (Dr. B. Chalmers and E. R. W. Jones), 307
Statistical Problems : Use of Stereographic Projection for (Prof. Cyril Burt), 338
Statistics in the Modern State (Lord Woolton), 686
Steam Tables : The 1939 Callendar (G. S. Callendar and Sir Alfred Egerton), second edition, *review* by Dr. H. Heywood, 462
Steam Tables and Steam Power (Prof. D. M. Newitt and N. R. Kuloor), 755
Steel-Cored Aluminium Conductors : Tensile Load on (E. W. W. Double), 305
Stereographic Projection : Estimation of Multiple Correlation by means of (G. F. K. Naylor), 58
Stereographic Projection for Statistical Problems : Use of (Prof. Cyril Burt), 338
Sterilization of Syringes, 745
Stilbœstrol Solutions (Dienœstrol and) : Instability of (A. E. Wilder Smith and P. C. Williams), 718
Stone Age in East Africa (M. C. Burkitt), 371
Stratosphere Aircraft : New, 44
Strength of Materials (British Rheologists' Club conference on), 306
Stress Cycles (Repeated) : The Behaviour of Natural Rubber and GR-S under (Dr. D. Parkinson and J. L. Bloxham), 11
Stressing : Strength of Glass and Duration of (F. W. Preston), 55
Striated Structure of Age-hardened Alloys (Dr. M. L. V. Gayler), 333
Structural Diagnosis by Infra-red Absorption : Chemical Analysis and, *review* by Dr. H. W. Thompson, 65
Structural Problems in the Polysaccharides : Application of New Methods of End-Group Determination to (F. Brown, Sonia Dunstan, T. G. Halsall, Prof. E. L. Hirst and J. K. N. Jones), 785
Structure, Degeneration and Repair of Nerve Fibres (J. Z. Young), 132
Sub-crystalline Regions in 'Hybrid' Crystals of Potassium Dihydrogen Phosphate : Laue Photographs of (Dr. A. R. Ubbelohde and Miss I. Woodward), 20
Substances (Solid) : Spectral Analysis of (Dr. J. Eeckhout), 175
Sugar Consumption of *Bact. coli* : Effect of Sulphanilamide on the (N. Klissiunis), 178
Sugar-Beet in Dry Climates : Chalk-washing of (Kolossov), 304
Sugar Beet Production : Mechanization of, 361
Sugars in Barley Seedlings on Very Acid Soil : Accumulation of (T. W. Barnes), 692
Sugars in Neutral Phosphate Buffer : Periodate Oxidation of (Gosta Lindstedt), 448
Sulphanilamide : Effect of, on the Sugar Consumption of *Bact. coli* (N. Klissiunis), 178
Sulphur Oxides : Influence of, on the Luminosity of Coal Gas Flames (Dr. G. Whittingham), 207
Sun : Microwave Radiation from the (G. C. Southworth), 274
Nuclear Energy Generation in the (N. R. Sen and U. R. Burman), 305
Radio Waves from the, 273
Spicules on the (Dr. Walter O. Roberts), 362
Sun Compass (Francis Chichester), *review*, 318
Sunset : The 'Green Flash' at, with a Near Horizon (D. R. Barber), 146 ; (Dr. C. E. P. Brooks), 368
Supernova in Canes (M. L. Humason), 777

Suprarenal Cortex . Thiourea and the (Dr Gertrude E Glock), 508
Surface Tension Measurement : Time Factor in (Dr. C. C Addison), 600
Surge Characteristics of a Three-Phase Transmission Line with Earth Wire (W. G Hawley), 305
Survival of a Fish after a Major Injury, 714
Suspensions : General Rheological Properties of (British Rheologists' Club and the Manchester Section of the Oil and Colour Chemists' Association discussion on), 745
Sweden's Water-Power Resources, 759
Swedish Oceanography during the War (Prof. Hans Pettersson), 180
Symbols Used to Indicate Hydrogen Ion Concentration and Similar Quantities (Dr. D. Clibbens), 176
Sympathomometic Pressor Substance in Animal Organ Extracts (Prof. U. S v. Euler), 18
Synaptic and Neuromuscular Transmission : An Electrical Hypothesis of (Prof. J. C. Eccles), 680
Synthesis of Adenosine Triphosphate by an Enzyme System from Ischæmic Muscle (Marian Bielschowsky and Prof H. N. Green), 117
Synthesis of Chondrosamine : A Constitutional (Dr. Sybil P. James, Dr. F. Smith, Dr. M. Stacey and Dr. L. F. Wiggins), 308
Synthetic Rubber from Alcohol (Anselm Talalay and Michael Magat), *review* by Dr. W. J. S. Naunton, 251
Syphilis : Penicillin in the Treatment of (Major James Marshall), 769
Syria . Plant Studies in (Prof. Zohary), 246
Syringes : Sterilization of, 745

TARTAR Deposition in the Ferret . Enamel Cuticle (Nasmyth's Membrane) and (Dr J D King), 572
Tea Chests The Testing of Indian Plywood for (V. D. Limaye), 668
Teaching by means of the Scientific Film (J. Maddison), 57
Team Work in Science, 581
Technical Training : The Film Strip in (H Richmond), 426
  Scientific Film Needs in (W. F. Andrews), 426
Technological Education . Higher, in Britain, 699
Technologist · The Education of the (Prof. J. B. Speakman), 57
Technology and Administration, 671
Technology of Food and Food Products · The Chemistry and (edited by Dr. Morris B. Jacobs), Vol. 2, *review* by Dr. T. Moran, 220
Teeth of Rachitic Rats (Incisor) : Effect of Restriction of Food Intake upon the (Prof J. T. Irving), 664
Teleosts Sexual Differentiation of the Gonad and the Sexualization of the Germ Cells in (Prof. Umberto D'Ancona), 603
Telepathy : A Theory of (A T. Oram), 303
Television System . New (Pye, Ltd.), 565
Temperature : Mass Departure of Locust Swarms in relation to (Dr. D. L. Gunn, Flying-Officer F. C. Perry, Flight-Lieut. W G. Seymour, Flight-Lieut. T M. Telford, A.C 2 E. N. Wright and D Yeo), 628
  Effect of, on Magnetic Susceptibility of Molybdenite Crystals (Ajit Kumar Dutta), 240
Temperature Effect on Ultra-sonic Velocity in Water (Bawa Kanwal Singh), 569
Tensile Load on Steel-Cored Aluminium Conductors (E. W. W Double), 305
Tension and Density in Solutions (Interfacial) : Time Dependence of (Prof. George Antonoff), 301
Termination Coefficients Propagation and, for Vinyl Acetate Photopolymerization (G. M. Burnett and Prof. H. W. Melville), 661
Tetrabromide of β-Phellandrene (P. A. Berry and Prof. A Killen Macbeth), 175
Terrestrial Magnetism and Atmospheric Electricity . Completion of the fiftieth year of publication, 472
Terrestrial Magnetism : Astronomy and, in the U S.S.R. (Sir Harold Spencer Jones), 324
Tetrahydroacridones and related Substances · Antimalarial Activity in (Joan M L. Stephen, Isabel M. Tonkin and James Walker), 629
Thames Estuary : Utilization of the Slipper-Limpet (*Crepidula fornicata*) as Food as an Aid to the Recovery of Oyster-Culture in the (Prof J H. Orton), 665
Thatch Grass (Dr. B C. Sharman), 342
Theileria annulata · Multiplication *in vitro* of Koch Bodies of (I. Tchernomoretz), 391
Theory of Gravitation (Milne's) : The Two-body Problem in (G. J. Whitrow), 365
Thermal Decomposition of $HgCl_2$ Vapour (Dr. K Wieland), 504
Thermal Diffusion in Gases · Effect of Pressure on (K. E. Grew), 267
Thermal History of the Earth (Dr. E. C. Bullard), 35
Thermomechanical Effects in Water . Flow of Water through Very Narrow Channels and Attempts to Measure (Dr. J. Reekie and J Aird), 367
Thermostabile, Fungistatic Factor from *Escherichia coli* (Sten Wiedling), 204
Thinking (Metaphysical) : The Nature of (Dorothy M. Emmet), *review* by Prof. L. J. Russell, 217
Thiourea and the Suprarenal Cortex (Dr Gertrude E Glock), 508
Thompson (Mary Clark) Medal of the United States National Academy of Sciences awarded to Thomas Wayland Vaughan, 575
Thought The Art of Medicine in relation to the Progress of (A. E Clark-Kennedy), *review* by Dr. G. Lapage, 488
Tick . An Arsenic-Resistant (Prof. J. Omer-Cooper and A. B M. Whitnall), 450
Tilden Lecture of the Chemical Society (Prof. E. D Hughes), 777
Timber : Protection of, against Powderpost Beetles, 16
Timber Resources of Britain, *review* by Major T. H. Hawkins, 613
Time Corrections by Equal Altitudes (Zinger's Method) for 1944 : Ephemerides for the Determination of (Astronomical Institute of the Academy of Sciences of the U.S.S.R.), 16
Time Dependence of Interfacial Tension and Density in Solutions (Prof. George Antonoff), 301
Time Factor in Surface Tension Measurement (Dr. C. C. Addison), 600
Time and its Lapse Rate : The Fitzgerald Contraction as the Origin of our Experience of (Prof. W. Peddie), 336
Time, Number and the Atom (R. Fortescue Pickard), *review* by F. J. Garrick, 489
Timor Português, contribuições para a seu estudo antropológico (Pr A. A. Mendes Corrêa), *review* by Prof. A. R Radcliffe-Brown, 1
Tissue Extracts in controlling *Staphylococcus aureus* Infections : Effect (Dr. Leo G. Nutini and Sr. Eva Maria Lynch), 419
Tissues (Animal) . Acetylphosphatase in (B Shapiro and E. Wertheimer 690
Titanates : Dielectric Constants of some (Dr. B. Wul), 480
Toadstools · Trees and (Dr. M. C. Rayner), *review*, 732
Tomato Fruits : Parthenocarpic Production of (Thomas Swarbrick), 300
Tones : Difference (A J. King), 536
  (Difference) : Production of (Prof. Frank Allen), 84
Toothache : Folk-Lore of (Dr. J D Rolleston), 387
Tory (Henry Marshal) Medal of the Royal Society of Canada awarded t Dr. Otto Maass, 271
Toxicity of D D T. to the Housefly (E A Parkin and A. A Green), 745
Toxicity to Fungi in Wareham Heath Soil : Origin of (Dr. M. C. Rayner) 174
Trade (Skilled) : Apprenticeship for a (F. Twyman), 155
Training : Education and, of Aircraft Workers, 78
  Man-Power and, in the Scientific Instrument Industry, 154
Training of Engineers (Prof. Andrew Robertson), 775
Transients (Electrical) : The Simple Calculation of (G. W. Carter), *review* by Dr. L. E. C. Hughes, 6
Transmission (Synaptic and Neuromuscular) : An Electrical Hypothesis o (Prof. J. C. Eccles), 680
Transmission Line (Three-Phase) . Surge Characteristics of a, with Earth Wire (W. G Hawley), 305
Transmission-line Problems : Long (R. H. Paul), 179
Transplantation of the Heart (Prof. Nikolai Sinitsin), 536
Trees : The Wood from the (Richard Jefferies), *review* by Major T. H. Hawkins, 613
  (Apple) : Abnormal Lignification in the Wood of some (Dr A. Bery Beakbane and Dr Eleanor C. Thompson), 145 ; *erratum*, 202
  (Fruit) . Phosphorus Deficiency of (L. R. Bryant and R Gardner), 178
  (Fruit) . Root Distribution of (E L. Proebsting), 395
Trees and Fungi, *review*, 732
Trees and Shrubs as Food for Cattle . Use of, 151
Trees and Toadstools (Dr. M. C. Rayner), *review*, 732
Trichoderma viride . Viridin, a Highly Fungistatic Substance produced by (Dr P. W. Brian and J. C. McGowan), 144
Triose and Triosephosphate Dehydrogenases of Muscle . Crystallization and Identity of the (Ranwel Caputto and Dr. Malcolm Dixon), 630
Tropical Ecological Studies : Need for Development of (Dr. V. J. Chapman, C. O. Flemmich, A. L. Griffith, J. L. Harley, R. Hobbins, C. H. Holmes, C. de Rosayro and J. Wyatt-Smith), 627
Tropical Pedology, *review* by Dr A. Muir, 93
Tropical Plains of Bengal : Artificial Production of Ergot in the (J. C. Saha and S. K. Bhattacharjee), 363
Trypanosoma congolense Broden : A Sexual Reproduction Cycle of (R. N. T.-S.-Fiennes), 390
Tubercle Bacilli : Fatty Constituents of, as Growth-Inhibitors of the same Bacilli (Dr. Ng. Ph. Buu-Hoï), 392
  Fluorescence Microscopy of (Dr. B. Juricic, Sr. Nicolás Vuskovic, Dr. Gastón González, Dr. Hernán Durán and Dr. Hipólito Vergara), 16
Tubercle Bacillus : Production of *p*-Aminobenzoic Acid by the (Torsten Ekstrand and Bertil Sjogren), 476
Tuberculosis : Chemotherapy of (Dr. M. A. Soltys), 210
  Familial Susceptibility to (Dr. Ruth Rice Puffer), *review*, 191
Tumbian Culture in East Africa : A Contribution to the Study of the (Dr. J. B. S Leakey and Archdeacon Owen), 371
Tumour Conditions · Experimental Imitation of (Dr. P. T. Thomas), 738
Tumours . Mammary, in Mice (Members of the Staff of the National Cancer Institute, United States Public Health Service), 787
Tumours Induced in Rabbits by 9 . 10-Dimethyl-1 : 2-Benzanthracene (Histologically Malignant) : Spontaneous Regression of (Stephan Beck), 238
Tunas (Pacific) A Systematic Study of the (H. C. Godsil and Robert D. Byers), 184
Turner and Newall Research Fellowships, 659
Twin Embryos in Angiosperms (Haploid-Diploid) : Origin of (Dr. P. Maheshwari), 173
2 × 2 Tables · A New Test for (G. A. Barnard), 177, 783 ; (Prof. R. A. Fisher), 388
Two-body Problem in Milne's Theory of Gravitation (G. J. Whitrow), 365
Two-Solution Cells . A Convenient 'Bridge' for (Dr. S. M. Neale), 506
Tyndall, John : Life and Work of (A. S. Eve and C. H. Creasey), *review* by Lord Rayleigh, 189
Typhoid, Cholera, Dysentery and *B. coli* . Anti-bacterial Action of 'Polyporin' against (Prof. S. R. Bose), 171
Tyrell Medal of the Royal Society of Canada awarded to Prof F. Landon, 271
Tyroglyphid Mites and Human Disease (Dr. G. Lapage), 427

ULTRACENTRIFUGAL Studies on Serum and Serum Fractions (Dr. Kai O. Pedersen), 247
Ultracentrifuge . Serum Proteins in the (J. St. L. Philpot), 247
Ultrasonic Velocities in Extended Solids : Measurement of (R. Parshad), 637
Ultra-sonic Velocity in Water : Temperature Effect on (Bawa Kanwal Singh), 569
Ultra-Violet Emission Bands : Near, of Benzene (Prof R. K. Asundi and M. R. Padhye), 368 ; (Prof C. K Ingold), 569
Ultra-Violet Light · Porphyrin Fluorescence in the Livers of Pellagrins in relation to (Dr. J. Gillman, Dr T. Gillman and S. Brenner), 689
Ultra-Violet and Daylight Rays in the Solar Cycle : Behaviour of (Dr. J. R. Ashworth), 115
Unborn · Ourselves (George W. Corner), *review* by Dr. C. H. Waddington, 375
Undialysable Pressor Principle in Organ Extracts (Prof. U. S. v. Euler and E. Östlund), 49
Uniformity · Origin of, *review* by Dr. John Cohen, 515
Unit Cell and Space-Group of Co_2-Al_9 (Audrey M. B. Parker), 783
United Nations, 1

United Nations : Draft proposals for an Educational and Cultural Organisation of the, 263
  The Educational and Cultural Organisation of the (Prof. Norman Bentwich), 445
  Post-War Educational Reconstruction in the (edited by Prof. I L. Kandel), *review*, 318
  Science and the (Dr. Julian Huxley), 553
United Nations Educational and Cultural Organisation—Introduction (Dr E. F. Armstrong), 553 ; Science and the United Nations (Dr. Julian Huxley), 553 ; World Co-operation in Science (J. G. Crowther), 556 ; A Permanent International Scientific Commission (Prof. J. D. Bernal), 557 ; The Place of Science and International Scientific Co-operation in Post-War World Organisation, 558
  Scientific Delegates to the, 565
United Nations Food and Agriculture Organisation, 727
United Nations Organisation : Science in the, 625
United States : Family Food Consumption in the (Miss M. W Grant), 441
  Forestry Problems in the, *review* by Prof. F. J. Lewis, 584
  Outstanding German men of science to be taken to the, 445
  Practice of Medicine in the (Interim Report of the New York Academy of Medicine Committee on Medicine and the Changing Order), 341
  National Parks in the, 15
  A Plan for Research in the, 130
  Research and Development in the, 360
United States Antarctic Discoveries (Prof. R. N. Rudmose Brown), 399
United States Typhus Commission Medal awarded to Dr. Francis G. Blake and Dr. Kenneth F. Maxcy, 445
Units : Pressure (E. Denne), 146
Units for Degree of Vacuum (Dr. R Feinberg), 85 ; (G. A. P. Wyllie), 85
Univalent Electron Transfers in Aromatic Nitration ? (G. A. Benford, C. A. Bunton, E. S. Halberstadt, Dr. E. D. Hughes, Prof. C. K. Ingold, G. J. Minkoff and R. I. Reed), 688
Universities . British, 263
  Colonial, and their Functions, 345, 373
  Some Comparisons between (Association of University Professors and Lecturers of the Allied Countries in Great Britain, Proceedings of the Second Education conference), 183
  Parliamentary Representatives of the, 168
Universities and the Needs of the Community, 183
University : The Idea of a (Sir Charles Grant Robertson), 263
  Science and the (Prof S. Brodetsky), 57
  (Modern) : Problems of the, *review* by R. Brightman, 432
University in the Modern World (A. S. Nash), 184
University and Research Libraries (Library Association conference on), 417
University Developments (Association of University Teachers, Second Report), 311
University Education and Business, 671
Unshrinkable Wool (W. J P. Neish and Prof J. B Speakman), 176
Uranium Custody of (Prof. Sidney Russ), 303
Urines (Human) : Primary Degradation Products of Mepacrine in (D Ll Hammick and S F. Mason), 718
U S.S.R. Recent Chemical Research in the, 697
  Manganese Deposits of the (A. G. Betekhtin), 87
  Non-Metallic Deposits of the (S. I. Tomkeieff), 759
  Research in the, on Conditioned Reflexes, 455
  Research in the, on the Physiology of Vision, 579
  Science in the :—Physiology (Prof. E. D. Adrian), 222 ; Contemporary Physics (Prof. E. N. da C. Andrade), 223 ; Archæology and Anthropology (Prof V. Gordon Childe), 224 ; Vertebrate Palæontology (Prof. D. M S. Watson), 225 ; Medicine (Prof. Arnold Sorsby), 226 ; Agrochemistry (Dr. E. M. Crowther), 227 , Evolutionary Biology and related Subjects (Dr. Julian Huxley), 254 , *errata*, 293 ; Crystallography (Dr. W. A. Wooster), 256 ; Pedology (Dr. Alex Muir), 258 ; Geology and Palæobotany (W. N. Edwards), 282 ; Physical Chemistry (Prof. C. N. Hinshelwood), 283 ; Surface Chemistry (Prof. N. K Adam), 284 ; Astronomy and Terrestrial Magnetism (Sir Harold Spencer Jones), 324 ; Theoretical Physics (Prof. M. Born), 325

VACUA · Comparative, produced by Different Oils in a Diffusion Pump (Kamalesh Ray and Nanda Dulal Sengupta), 635
Vacuum : Units for Degree of (Dr. R. Feinberg), 85 ; (G. A P. Wyllie), 85
Vanadium, Chromium, Cobalt and Nickel in Eruptive Rocks : Distribution of (Prof. L. R. Wager and R. L. Mitchell), 207
Variable (Complex) · Functions of a, *review* by J. H. Pearce, 67
Vasomotor and Cardio-Regulatory Centres (Respiratory,) : Influence of Blood Pressure and Blood Flow on the Activity of the (Prof. C. Heymans), 750
Vegetable and Fruit Growers' Conferences (edited by Dr. D H. Robinson), *review*, 489
Velocities (Ultrasonic) : Measurement of, in Extended Solids (R. Parshad), 637
Velocity (Ultrasonic) : Temperature Effect on, in Water (Bawa Kanwal Singh), 569
Venereal Diseases : The, 501
Ventricular Gradient · New Basic Concepts in Electrocardiography—The (Dr. W. F. Berg), 590
Vernal Increase in the Phytoplankton and a Supposed Lag in the Process · Conditions for the (Dr. W. R. G. Atkins), 599
Vertebrate Palæontology in the U.S.S.R. (Prof. D. M S Watson), 225
Veterinary Services in the Far East . British Army (Dr. G. Lapage), 60
Vinyl Acetate Photopolymerization : Propagation and Termination Coefficients for (G. M. Burnett and Prof. H. W. Melville), 661
Vinyl Compounds The Mechanism of Polymerization of (Prof. H. W. Melville), 639
Violet : Darkened, in Colour Vision (Dr. R. W. Pickford), 506
Viridin, a Highly Fungistatic Substance produced by *Trichoderma viride* (Dr. P. W. Brian and J. C. McGowan), 144
Virus (Bacterial) : Mutations in (S. E. Luria), 304
Virus Disease Symptoms on Potato Foliage : Frost Injury Simulating (Robert McKay and Dr Phyllis E. M. Clinch), 449
Viscosity : Degree of Association of Water from the Energy of, and the Work of Cohesion (L. Grunberg and Dr. A. G. Nissan), 335
Viscosity of Ordinary Liquids at High Rates of Shear (L. Grunberg and Dr. A H. Nissan), 241
Viscosity of Liquids and Colloidal Solutions (Academy of Sciences of the U.S.S.R conference on), 147
Visible Glow Discharge at Very Low Potentials (Dr. A Sommer), 242
Vision · Research in the U.S.S.R. on the Physiology of, 579
  (Colour) : Darkened Violet in (Dr. R. W. Pickford), 506
  (Colour) : Electrotonus in (Prof. S. V. Kravkov and L. P. Galotchkina), *erratum*, 626
Visual Cortex in Man : The Organisation of the (Dr. Gordon Holmes), 201
Vitamin A · Effect of High, in the Diet of Domestic and Non-Domestic Animals (Hilda H Wheeler), 238
Vitamin A Deficiency and the Requirements of Human Adults, 11
B Vitamins in African Fermented Foods (Dr. Leon Golberg, J. M. Thorp and Sheila Sussman), 364
Vitamin B_2 Complex (Joint meeting of the Nutrition Society and the Biochemical Society on the), 86
Vitamin C Peroxidasic Activity (Dr. N. Bezssonoff and Dr. Hèlene Leroux), 474
Vitamin E on the Utilization of Carotene from Oils : Influence of (S. Dattatreya Rao), 449
Volcanoes as Landscape Forms (Prof. C. A. Cotton), *review* by Prof. Arthur Holmes, 156
Volcanological Station of Kamchatka (V. I. Vlodavetz), 640
Voltages (High) : Measurement of (Dr J M. Meek and F. W. Waterton), 422
Vredefort 'Dome' : Structure of the (B. D. Maree), 304
Vulcanisates (GR-S) The Heat Ageing of (Dr. J. R. Scott), 10

WAR · Belgian Biological Publications during the, 166
  British Electrical Engineers and the (Dr P. Dunsheath), 482
  Colorado Beetle in England during the, 776
  Czech Botanists during the, 416
  Government Control in (Lord Hankey), 457
  Lessons of the, for Scientists (Prof. J. D. Bernal), 659
  Psychology of, *review* by Dr. William Brown, 314
  Radar during the, 444
  Science and, 659
  Swedish Oceanography during the (Prof. Hans Pettersson), 180
  (Second World) : The End of the, 187
War Years : British Museums during the, 26
War and After : Fertilizers during the (Dr. E M Crowther), 776
War and Peace : Explosives in, *review* by Prof. John Read, 5
  The British Radio Industry in, 713
War and in Peace : Radar in (Sir Robert Watson-Watt), 319
Wareham Heath Soil : Origin of Toxicity to Fungi in (Dr. M C. Rayner), 174
War-time Foods Nutritive Values of (Medical Research Council War Memorandum No. 14), 330
Washington British Agricultural Attaché at (Appointment of A. N Duckham as), 138
Water : Degree of Association of, from the Energy of Viscosity and the Work of Cohesion (L. Grunberg and Dr. A. G. Nissan), 335
  Flow of Water through Very Narrow Channels and Attempts to Measure Thermomechanical Effects in (Dr J. Reekie and J. Aird), 367
  Temperature Effect on Ultra-sonic Velocity in (Bawa Kanwal Singh), 569
Water-chestnut, *Eleocharis tuberosa* (Chinese) : An Antibiotic Substance in the (S. L. Chen, B. L Cheng, W. K. Cheng and P. S. Tang), 234
Water-Power Resources : Sweden's, 759
Water-Shrew, *Neomys fodiens* : Mass Movement of the (Frances Pitt), 247
Water Vapour : Hysteresis in the Adsorption of, by Wheat (Dr. J. D. Babbitt), 265
Waveform Analysis (R. G. Manley), *review* by Dr. L. E. C. Hughes, 765
Wave-lengths for European Broadcasting, 250
Wax : Ester, a New Embedding Medium (Dr. H. F Steedman), 121
Weathering of GR-S (H. C. Harrison), 10
Weber-Parkes Prize and Medal of the Royal College of Physicians awarded to Prof Eugene L. Opie, 531
Weed Control in Cereals (Ministry of Agriculture Advisory Leaflet No 315), 330
Wellcome Fellowships for Veterinary Research awarded to Christopher W. Ottaway and Herbert Williams Smith, 45
Wheat : Hysteresis in the Adsorption of Water Vapour by (Dr. J. D. Babbitt), 265
White Dwarf Binaries (Dr. W J. Luyten), 293
Wild Flowers : Common (John Hutchinson), *review* by Prof. F J. Lewis, 461
Wire (Exploded) : Spectra of Diatomic Oxides by the Method of (B Rosen), 570
Witchcraft in England (Christina Hole), *review*, 765
Woman Farmer : Experiences of a, *review* by Sir John Russell, 230
Wood : Compregnated (D Narayanamurti and Kartar Singh), 787
Wood of some Apple Trees : Abnormal Lignification in the (Dr A Beryl Beakbane and Dr. Eleanor C. Thompson), 145 ; *erratum*, 202
Wood from the Trees (Richard Jefferies), *review* by Major T. H. Hawkins, 613
Wood and Glue (Dr. M. C. Pryor), 306
Woodlice : Duration of Life of (Dr. Walter E. Collinge), 755
Wool : Unshrinkable (W. J. P. Neish and Prof. J. B. Speakman), 176
Wool Fibres : Frictional Properties of (M. Lipson), 268
  Scaliness of (J. Menkart and Prof. J. B Speakman), 143
Wool Research Scholarship . Grant of £300 a year by the International Wool Secretariat to the University of Leeds for the establishment of a, 502
Worker : Output and the (P E P Broadsheet), 91
World (Modern) : The University in the (A S Nash), 184
World Co-operation in Science (J. G. Crowther), 556

World Organisation (Post-War) : The Place of Science and International Scientific Co-operation in (Dr. Joseph Needham), 558
World of Plenty : Towards a (United Nations Information Organisation), 727
World To-day : To replace the *Bulletin of International News*, 167
World War (Second) : The End of the, 187
Worms : Palolo (Prof. Hubert Lyman Clark), 508
  Palolo, in Pacific Waters (A R. Lever), 19

X-RAY Adventures among the Proteins and other Molecular Giants (Dr. W. T. Astbury), 427
X-Ray Analysis with the Aid of the 'Fly's Eye' (Sir Lawrence Bragg and A. R Stokes), 332
X-Ray Crystallography at Cambridge : Summer School in, 566
X-Ray Methods in the Metal Industry (Society of Czechoslovakian Mathematicians and Physicists conference on), 473, 502
X-Ray Study of the Solution of Alkali Halides in Borax and B_2O_3 Glas Systems (S. K. Majumdar, B. K. Banerjee and K. Banerjee), 423
X-Rays : Fiftieth Anniversary of the Discovery of, 502, 533
  Fifty Years of, 531
  Measurement of the Diameters of the Living Eye by means of (Prof Arnold Sorsby and A. D. O'Connor), 779
  An Attempt to obtain Nuclear Excitation by means of (Sigvar Eklund), 690
Xylenes : Interaction of Aluminium Halides with the (H. Campbell an E. F. G. Herington), 389

YEAST : A Colour Reaction in (Mignon Malm), 52
Yeast Hexokinase and its Substrates *d*-Fructofuranose and *d*-Glucose (Dr A. Gottschalk), 540
Yeasts (Capsulated) : Production of Extracellular Starch in Cultures o (Dr. M. Aschner, J. Mager and Dr. J. Leibowitz), 295

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CONTENTS

Page
e United Nations 1
A.F. Aerial Survey in Peace-time 2
enetics and Major Evolutionary Change. By Dr. Julian S. Huxley, F.R.S. 3
xplosives in War and Peace. By Prof. John Read, F.R.S. 5
tential Theory. By J. H. Pearce 5
perational Calculus. By Dr. L. E. C. Hughes . . 6
irect Chemical Action upon Nerve Centres in Biology and Medicine. By Prof. Lena Stern 7
hysical and Chemical Degradation of Rubber. By Dr. D. F. Twiss 9
itamin A Deficiency and the Requirements of Human Adults 11
bituaries :
  Prof. Alexander Fersman. By Prof. C. E. Tilley, F.R.S. 12
  Sir Martin Forster, F.R.S. By Prof. J. L. Simonsen, F.R.S. 13
  Prof. John Borg. By W. B. Turrill . . . 14
  Prof. E. Rádl. By Dr. G. Druce . . 14
ews and Views 15
etters to the Editors :
  Individual Hæmoglobins.—Prof. H. Munro Fox, F.R.S. 18
  A Sympathomometic Pressor Substance in Animal Organ Extracts.—Prof. U. S. v. Euler 18
  Presence of Reddish Pigment in Eggs and Ovarioles of the Desert Locust, and its Probable Phase Significance.—Dr. M. L. Roonwal . . . 19
  'Palolo' Worms in Pacific Waters.—R. A. Lever . 19
  A Factor in Clover Nodule Formation Associated with the Volume of the Medium Occupied by the Roots.—Dr. P. S. Nutman 20
  Laue Photographs of Sub-crystalline Regions in 'Hybrid' Crystals of Potassium Dihydrogen Phosphate.—Dr. A. R. Ubbelohde and Miss I. Woodward 20
  Afterglow Effects in High-Pressure Gases.—Dr. J. D. Craggs and Dr. J. M. Meek 21
  Allotropic Modifications of Diamond.—Sir C. V. Raman, F.R.S. 22
  Infra-Red Spectrum of Diamond.—K. G. Ramanathan 23
  Shear Modes in Non-Piezo-Electric Crystal Plates.—Prof. S. Bhagavantam and J. Bhimasenachar 23
Combined Raw Materials Board 24
Microfilm and Other Means of Documentary Reproduction. By L. V. Chilton 24
British Museums during the War Years 26
Historical Library of Yale University School of Medicine. By Dr. G. Lapage 27
Marine Ecology in South Africa 27

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THE UNITED NATIONS

THE San Francisco Conference which issued in the United Nations Charter, signed on June 26, after nine weeks deliberations on the proposals formulated last autumn at Dumbarton Oaks, by the fifty nations represented, has been compared by President Truman with the Philadelphia Convention of 1787 which led to the framing of the Constitution of the United States. Like that Constitution, the United Nations Charter represents a compromise, the outcome of close debate and sometimes sharp exchange of conflicting opinions. Like that Constitution again, the Charter is not claimed to be a final or perfect instrument; and, more clearly than the Covenant of the League of Nations, it provides expressly for its own revision and modification in the light of experience.

Whether the San Francisco Conference will take its place in history with the Philadelphia Convention has yet to be seen. It is only the first step towards a lasting peace—the forging of an instrument, which, whatever the merits or demerits of its content, is truly what the League of Nations never was, a world organization. The signatures on the same Charter of the United States and of Soviet Russia is a greater achievement than any of its 111 articles, and the promptness with which President Truman has sent the Charter to the United States Senate for ratification, and the Russian disposition to stress the responsibilities of the major Powers rather than their privileges, are hopeful signs. Even more hopeful is the sober restraint which has characterized the recognition of this great achievement. There is now far wider recognition that no international instrument, no constitutional specific will suffice to maintain peace; and the absence of extravagant hopes may be one of the firmest assurances that the Charter will command the loyalty and understanding which alone can make it effective.

Regional arrangements are clearly encouraged, the need for peaceful change is duly emphasized, and the clause inserted in Article 1 affirming as one purpose "international co-operation . . . in promoting and encouraging respect for human rights and for fundamental freedoms for all without distinction as to race, sex, language, or religion", does something to meet the call for an international bill of rights inspired by the terrible atrocities of recent years. The biggest step in meeting American criticisms of the Dumbarton Oaks scheme is probably the inclusion of entirely new chapters on trusteeship for non-self-governing territories. These three chapters involve the establishment of an international trusteeship system with a trusteeship council possessing similar functions to those of the League Mandates Commission.

The system thus established holds promise of removing some of the causes of friction and misunderstanding between Great Britain and the United States, as well as between other countries; and these articles, with their emphasis on the encouragement of research and promotion of development, are of special interest to scientific workers. A like observation may be made of the second major addition to the Dumbarton Oaks document—the much fuller elaboration of the scope and functions of the Economic and Social Council. Dismissed rather perfunctorily in Chapter 9 of the Dumbarton Oaks proposals, this scheme has now been developed at length in Chapters 9 and 10 of the new Charter embracing Articles 55–72. The Economic and Social Council, which will consist of eighteen members, is now named as one of the principal organs of the United Nations, and its duties will include that of initiating research and of recommending action to the Assembly on all international economic and social questions, including health.

This is not the place for a detailed examination of the nineteen chapters and 111 articles to which the Charter now runs, but the importance of the document cannot be over-emphasized. It represents first, as already noted, the cardinal and central fact that it is the duty of the powerful nations to assume the responsibility of leadership towards a world of peace, though it should not be forgotten that restraint will also be demanded of the smaller countries in the Economic and Social Council and in the Assembly if dissensions are not to arise. Next, the Charter represents a reasonable attempt to utilize available experience, both of regional bodies and of functional organizations. As President Truman rightly said, it shows that the lessons of military and economic co-operation during the War have been learnt, and that the pooling of experience and resources in the work of the Combined Raw Materials Board, the Food Board and the Combined Chief of Staffs Committee is to be turned to our advantage for the purposes of peace and not rashly jettisoned as in 1919.

But despite the embodiment of such methods and experience in the new Charter, and its close relation to the policies and organization already represented by the United Nations Relief and Rehabilitation Administration, the Food and Agricultural Organization, the monetary Conference at Bretton Woods, and the aviation conference at Chicago, the kernel of the new organization is the Security Council; and, like the League of Nations, the United Nations will ultimately stand or fall by the success or failure of its machinery for the maintenance of peace.

The Charter itself is nothing if it fails to hold the loyalty of the major Powers, who alone can give it body and life. Already it is clear that the leaders of Great Britain, the United States, and the U.S.S.R. are ready to assume the responsibility of leadership towards a world of peace. In addition, we require indeed an effective agency for constant and thorough interchange of thought and ideas, through which alone can come a better and more tolerant understanding among nations and among peoples. An enduring peace involves a victory in the minds of men over the evil ideas and passions that have divided mankind and plunged the world into chaos. It involves the formation of a world opinion which clearly understands the price that has to be paid for peace, the restraints which must be accepted as the alternative to anarchy—the limitations as well as the opportunities of world organization. The creation of that opinion is a matter of education in which there is a place for every man and woman of good will.

R.A.F. AERIAL SURVEY IN PEACE-TIME

THE necessities of war have brought about th development of photographic reconnaissanc upon a scale previously unapproached, and at technical and administrative level of great competence. To achieve this the Royal Air Force ha built upon the pioneer experience of the War c 1914–18, on Services and commercial experienc between the Wars, and on the scientific knowledg of many types of imported specialists in fields relate to aerial survey, such, for example, as archæologists geographers and ecologists.

Now that a stage of hostilities has been reache when peace-time organization deserves attention it is appropriate to recognize that in this branc of R.A.F. activities there exist material an experience of great potential value for those year of post-war development which lie ahead, an during which Great Britain cannot afford to neglec any prospective means of scientific and technica advancement.

These considerations are prompted by a memorandum circulated by the British Ecological Society to scientific authorities and responsible governmen departments, and headed "Memorandum on th Establishment of an Aerial Unit for Scientific Work". Ecology, which has been defined as "scientific natural history", has brought modern techniques of science to bear upon the complex phenomena of plant and animal life in relation to its natural environment. Its workers have constantly concerned themselves with problems of relationships between vegetation, animal life, topography and soil. Their outlook has progressively established itself as fundamental to the disciplines of forestry, agriculture, geography and archæology. It is suitable therefore that ecologists should raise this issue; but it must be apparent that even wider fields than those they mention can be served by the widespread use of aerial mapping.

Photographic aerial survey has immense advantages over ground mapping: apart from the speed with which maps can be constructed from an air survey, air photography records automatically a multitude of distributional features of vegetational, geological, archæological and economic interest, and these remain available for inspection and analysis in the photographic prints. The aerial photographer, even when mapping without specific aim, cannot help but record an infinity of useful facts, of which he remains unaware, but which deliberate ground mapping could either not yield at all or yield only with immense labour. The value of this speedy, accurate and comprehensive mapping is too apparent to need stressing. It immediately affects geography, engineering, economics, and regional and town planning, especially perhaps in areas of great extent, complexity, or inaccessibility. It is, however, to its great potentialities in less obvious directions that our attention is now specially directed.

Archæologists were from the first keenly aware of the potential value to them of the point of view given y the aeroplane, and many new and important sites ave been disclosed by its aid. Thus air photography d to the excavation of Woodhenge in Wiltshire, nd its counterpart at Arminghall in Norfolk, and isclosed the Romano-British system of field boun- aries in relation with the prehistoric river systems f the East Anglian fens. Readers will indeed already e familiar with such achievements through the ublications of Mr. O. G. S. Crawford on the subject, nd through the admirable pioneer investigations of Ving Commander Insall.

Foresters have seized the opportunities of aerial urvey no less readily. Dr. Dudley Stamp in 1925 published results of an aerial survey of Burmese forests in the Irrawaddy Delta ; Dr. Bourne, of the Imperial Forestry Institute, in 1930, indicated its mmense potentialities in regional survey, illustrating his thesis by the aerial survey of tracts of southern England ; Dr. B. Lindquist of Lund was able, by ir survey at a season when the beech foliage con- rasted with that of other trees, to complete a survey of the beech forests throughout southern Sweden ; and more recently foresters in Canada and the United States have mapped and classified immense areas of forest land, and from the air photographs have derived information not only of vegetation types, tree species, and tree density, but also details of composition, age, and structure of the most direct importance to forest management. Other vegetation surveyed from the air includes types so divergent as prairie, sphagnum bog, coastal cliffs and submerged seaweed beds. Very often the changes such types show are intimately associated with topographic processes of great importance, such as those of soil erosion and coastal modification. The study of aerial plankton, the wind's freight of dust, pollen, bacteria, fungus spores and aphids, the rapid detection and report of the movements of big game or of locust swarms, the control of pests by spraying or dusting from the air, are yet other instances which indicate the wide scope of further application of the aeroplane to the service of biological science.

With the proved value of these applications in mind, and supported by an informative schedule of provisional schemes of investigation, the British Ecological Society suggests that after the War there should be established a permanent R.A.F. unit the services of which should be available for scientific work, not necessarily limited to photographic survey though chiefly concerned therein. To the arguments which are offered of the scientific potentialities of air survey thus fostered we would add that the effect upon the service unit of constant contact with men of science of varied kinds, and of attempts jointly with them to solve scientific problems of diverse character, must have the effect of keeping outlook and methods flexible and modern. Moreover, just as in war-time photographic survey has drawn extensively upon the services of academic men of science to help in such problems as the evaluation of cover, penetrability, and similar qualities of unfamiliar vegetation, so it remains desirable from the service point of view to keep and strengthen the links already made with such men of science.

The air photographs already obtained by the R.A.F. are of immense value to Britain, and the memorandum rightly recommends the establishment of a central library of air photographs available for scientific use. There should be destruction of negatives and prints of aerial photographs only where national security clearly demands it : the normal course should be for all good-quality negatives to go to the central library for indexing, and flights for training in air photography could with advantage regularly be made over targets selected for scientific usefulness.

We have mentioned but a fraction of the scientific issues touched by the new proposal, but it is clearly one which must receive warm support from men of science in all parts of the Commonwealth. If suitable administrative machinery can be devised, it should become a tool of great usefulness, helping men of science to maintain in the peace the quality of service they have so conspicuously upheld throughout the War.

GENETICS AND MAJOR EVOLUTIONARY CHANGE

Tempo and Mode in Evolution

By George Gaylord Simpson. (Columbia Biological Series, No. 15.) Pp. xviii+237. (New York : Columbia University Press ; London : Oxford University Press, 1944.) 23*s.* 6*d.* net.

IN "Tempo and Mode in Evolution" G. G. Simpson has done for palæontology what Ernst Mayr, in his "Systematics and the Origin of Species", did for taxonomy—he has reviewed the facts of his special branch of biology in the light of modern genetics. The result is an interesting and significant contribution to the synthesis now occurring in the general field of evolution.

Palæontology had indeed tended to build up its own set of evolutionary concepts, such as orthogenesis, racial senility, evolutionary momentum, and the like, between which and the concepts of neo-mendelism there seemed to be little or no possible connexion. Dr. Simpson has performed the double task of reminding neo-zoologists of many facts of palæontology which they have tended to overlook as unfamiliar or inconvenient, and at the same time showing the possibility of accounting for them in genetic terms.

The most familiar phenomenon brought to light by palæontology is the existence of evolutionary trends, as in the horses, the titanotheres, and almost every group of which there is abundant fossil record. The term orthogenesis has been applied to these sometimes as a description, sometimes as an explanation. Dr. Simpson reminds us that in point of fact these trends, though often broadly directional, are rarely rectilinear for more than short periods, that they may change in rate, that they may be reversed, that they show much branching (the horse stock has at least twelve branches of generic rank, besides the conventionally 'main' line leading to *Equus*). The facts are "flatly inconsistent with the idea of any inherent rectilinearity, predetermined trend, or solely preadaptive control". They can, however, be explained on the basis of orthoselection—selection acting in general in the same direction over long periods.

As a minor additional mechanism, he agrees that certain facts which otherwise demand a mysterious directional urge can be explained as by-products of allometric growth : thus Robb's data indicate clearly that the relative increase of facial length in horses is an automatic by-product of increase in absolute body-size. There are some rather disturbing theoretical consequences of such potentialities being implicit in the original short-faced ancestor; but if we recognize that selection can alter the rate of allometry (a point not clearly brought out by the author) the difficulties are not so great.

At any one period, each main trend or line tends to break up into separate species, adapted to slightly different environments. This Dr. Simpson would explain in essentially the same way as the taxonomist explains the formation of present-day species—by isolation, usually geographical, followed by divergence under the influence of selection. He would, I gather, attach rather more importance to the separating-out, by means of geographical isolation, of different characters, already co-existing in the original population. In support of this point, he adduces some facts (from ammonites) which show that a new line may have unusually low variability at the time of its origin, but that this is later gradually increased to normal. Such studies will be of great importance for evolution theory*.

A fact neglected by most zoologists is that within a general gradual trend, qualitative differentiation may occur, and if so, appears to be (geologically speaking) rapid. Thus the transition from browsing to grazing teeth occurred, in the ancestral true horses, during the Miocene. Dr. Simpson's analysis of this is very interesting. Grazing requires extremely long (hypsodont) teeth, because the food is so abrasive. However, even in browsing types increased size alone means somewhat greater hypsodonty, to meet the greater length of life. For this reason, by the early Miocene, equid teeth were beginning to approach a height suitable for grazing, so that then and only then could selection for grazing begin to act, and suitably isolated populations could evolve rapidly in the grazing direction.

Dr. Simpson then reminds us of the large gaps in the palæontological record, and of the consistency of their occurrence. In spite of the great progress made in tracing continuity of evolution *within* mammalian orders, no fossils have been found bridging the gaps between orders; and this phenomenon is virtually universal. To account for this, he supposes that, for one reason or another, breeding populations in the missing lines were at such periods isolated and small. As Sewall Wright has shown, in such populations evolution may be more rapid than normal, but is also largely non-adaptive. However (and here Dr. Simpson makes a rather new point), such non-adaptive evolution, in relation to existing conditions, may in occasional cases be pre-adaptive in relation to a new mode of life or a new environment; and if so, there will be strong selection-pressure favouring further adaptation along these lines.

If this is correct, we should scarcely ever expect to find transitional forms, as these would be extremely few in numbers and their evolution into the new typ would be unusually rapid.

The only question which will occur to geneticist is whether the very small isolated populations postulated by Sewall Wright as needed for non-adaptiv evolution could persist for the millions of years postulated by Dr. Simpson (for example, p. 121) for hi periods of rapid major change.

When a new favourable area is invaded, a 'explosive' evolution generally occurs, and we ma then find some of the process preserved in fossils. Thus among the South American ungulates in thei earliest phase, "there are so many transitiona forms, some of them quite plainly adaptively unstable, that the taxonomic problem seems almos hopeless".

Dr. Simpson explicitly rejects Goldschmidt's view that large-scale evolution operates by sudden rearrangements of the germinal material to produce new 'reaction systems', and indeed adduces many arguments against it. His main thesis is that there are three main types of evolution—speciation, phyletic or gradual directional change, and the rapid major changes we have just discussed, to which he gives the perhaps not very satisfactory name of 'quantum evolution'. The attention of palæontologists has been chiefly focused on phyletic trends, that of neo-zoologists on speciation : the time has now come for an exchange of views.

There are many other points of interest discussed by Dr. Simpson. One is the question of evolutionary rate. Thus, on palæontological evidence, he is able to conclude that "carnivores have evolved, on an average, at least ten times as fast as pelecypod molluscs". Within a phyletic trend, different branches may show markedly different rates for the evolution of a given character.

It seems clear that the general phyletic evolution of a group may be slow, as seems to be the case for Pelecypods. But there is also the point that phyletic evolution may reach a limit, when specialization has been pushed as far as ortho-selection can take it (most mammalian orders) : after this limit, phyletic evolution will cease and be replaced, in Dr. Simpson's terminology, by speciation (though this may extend to the production of new genera). With this, the rate of evolutionary change will clearly be much slowed down. I think that palæontology should further clarify this question of different types of slow evolutionary rate and the reasons for them. Attention might also have been given to the difference between (one-sided) specialization and (all-round) progress, and its genetic implications.

However, we must not quarrel with a pioneer for not having covered every aspect of the subject. He has introduced us to a new field, where the co-operation of geneticists, taxonomists and palæontologists is needed. The palæontologist alone can provide certain types of data urgently required for any comprehensive theory of evolution. But as Dr. Simpson points out, the main part of his work in this field is still to do; even with such a well-worked group as the horses "the study of equid evolution has barely begun"! The neo-zoologists can play their part by suggesting what types of investigation are most needed, and later by helping in the interpretation of the results.

Meanwhile biologists will be grateful to Dr. Simpson for a stimulating book, undoubtedly destined to be the parent of much new work and many valuable conclusions.

JULIAN S. HUXLEY.

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* In connexion with variability, Dr. Simpson's statement that man does not show an unusually high degree of variability would appear to apply to groups within the human species, not to the species as a whole. Further clarification of this point is desirable.

EXPLOSIVES IN WAR AND PEACE

The Science of Explosives

An Introduction to their Chemistry, Production and Analysis. By Prof. Martin Meyer. Pp. xi+452. (New York: Thomas Y. Crowell Co., 1943.) 4.50 dollars.

MODERN warfare calls for the rapid liberation, on an enormous scale, of free nitrogen from organic combination, with a correspondingly swift and lavish release of hoarded energy. This process is brought about through the intermediary of explosives. Contrary to the popular impression, explosives do not administer solely, or even mainly, to the destructive activities of 'the devilish cannon' and its complicated progeny. Explosives do not fade into insignificance in times of peace, although they may forsake the headlines. In the book under notice Prof. Meyer states that in 1940 more than 95 per cent of the total production of explosives in the United States was devoted to various essential activities of peace-time, such as the mining of coal and minerals and the accomplishment of construction work of many kinds. The American peace-time production of 423 million pounds in 1940 underwent a tremendous expansion after the Japanese attack on Pearl Harbour. "A first-class nation," states the author, "may annually use as much as 300,000 tons in peace, and this figure may rise to 3,000,000 tons or more in war."

A little reflexion will show what enormous inroads global warfare is bound to make, for the production of explosives only, upon the world's resources of fats, cotton, and coal, to say nothing of a great variety of other indispensable materials. A little more reflexion will reveal that explosives are not unique examples of discoveries that man has richly misapplied. To take a simpler example, explosives are concentrated forms of fire; and fire, as we know, is a good servant but a bad master. Man must learn to control the application not only of fire and of explosives, but also of thousands of other discoveries and inventions. This means, in the last analysis, that he must learn to control himself. That would be his crowning achievement.

In the work before us, the author offers in a clear and compact form an account of the chief types of explosives, and there are also chapters dealing with more general aspects of the subject, such as the theory of explosive action, grain size and shape, practical explosive and initiatory devices, together with descriptions of the inspection and analysis of explosives and of their application and use. Notes on the packing, shipping, storage, and safety of explosives are followed by a bibliography and index. Much additional information is given in the numerous tables and illustrations. Altogether, the work provides a handy and readable store of information, presented from an American point of view, for all who are interested in the nature, manufacture, properties, analysis, and applications of explosives.

A major criticism applicable to the book is that a specialized treatment of explosives scarcely calls for detailed descriptions, amounting to the best part of two chapters or some 10 per cent of the text, of the manufacture and properties of sulphuric and nitric acids; moreover, it seems unnecessary to include an illustration of a chemical balance, with directions for using it and for calibrating weights, or to devote the whole of four end-papers to a reproduction in duplicate of a table of the atomic numbers and atomic weights of 86 elements. A lack of proportion is shown also in the allocation of only seventeen pages to the important topics of black powder, pyrotechnics, and incendiaries.

Coming to one or two points of detail, it is unorthodox to discuss orientation effects in aromatic nitration under the title of "stereochemistry of the nitro compounds". Also, in spite of a decided paucity of simple expositions of explosives, it is not strictly accurate to claim in the prefatory statement that "there is an absence of material of this kind written in relatively simple and readable style and assembled in one book". What is perhaps the simplest of all such treatments is not mentioned in the lengthy bibliography. JOHN READ.

POTENTIAL THEORY

The Theory of Potential and Spherical Harmonics

By Wolfgang J. Sternberg and Prof. Turner L. Smith. (Mathematical Expositions, No. 3.) Pp. xii+312. (Toronto: University of Toronto Press, 1944.) n.p.

THIS book is the third of a series published under the auspices of the University of Toronto, to meet the ever-growing need for mathematical books in English, which bridge the gap between the elementary text-book and the exhaustive (and often exhausting) treatise.

The important subject about which the authors have taken it upon themselves to write is an example of this nature. Kellogg's "Foundations of Potential Theory" could be regarded as the treatise, in this case, and there are many elementary books in mathematical physics which contain, among their pages, sections and paragraphs (often scattered and badly presented) dealing with those aspects of potential theory necessary for their particular applications. Nowhere, however, until the publication of this volume, was there any connected account, in English, of the subject which could be read as a 'subject-in-itself' by those desirous of making its acquaintance for its own sake.

In spite of the valuable material to be found in its pages, this book just fails to reach the high standard which the authors set out to attain. Within the compass available, it seems undesirable to insist on too much pure mathematical rigour, particularly when the physical aspect has, perforce, to suffer in consequence. Complete and elaborate convergence arguments fulfil an essential role in a treatise or specialized tract in function theory, but those which are merely elaborate, and yet still incomplete, serve very little purpose, especially in a work of this kind. Again, the authors take great care to point out that consistent use of vector analysis is a characteristic feature of their book; but there are very few places where it has been used at all, except to convert a result which has been derived (often unnecessarily laboriously) in some co-ordinate system, into vector notation. Not only is there a large amount of time and space wasted in this way, but the reader also inevitably gets the entirely false impression that the use of vectors in mathematical physics is completely artificial.

As an illustration, the symbol $\partial/\partial n$, denoting differentiation along the normal to a curve or surface, is occasionally written as n. grad; but scarcely ever as the compound operator $\mathbf{n}.\nabla$, whereas it is only in this guise that its real significance as an invariant operator manifests itself.

After a brief introduction on the ideas of vectors and scalars, the book opens with two chapters dealing with Newtonian force fields in two and three dimensions and the corresponding potential functions *in that order*. This, in itself, seems an unfortunate beginning, for in most of the elementary problems in mathematical physics the force fields are calculated *after* the potential has been derived. It would seem to be much more reasonable to define the potential as a line-integral, pointing out necessary and sufficient conditions for its existence, and to deduce from it the vector equation $\mathbf{F} = -\nabla U$; and then proceeding to show at once that the Newtonian inverse square law of attraction is derivable from the potential $U = 1/r$, and finally building up the more complicated functions (for example, those due to doublets, surface and volume distributions, and so on) by the ordinary processes of integration and summation.

Chapter 3 discusses the so-called integral theorems: namely, the theorems of Gauss and Stokes and their various corollaries. It is in this chapter that the authors really fail to give their vector analysis a free hand. It is true that the complete proofs of these theorems present formidable topological difficulties; but as these have been laid aside, in any event, as being outside the scope of such a work as this, there can be no excuse for not presenting simple and elegant proofs along formal lines. Furthermore, the theorems of the equivalent layer (or Green's formulæ) follow much more obviously by vector methods than by the (admittedly equivalent) Cartesian methods used in the text.

In the fourth chapter, the ideas of expansion of potential functions in series of spherical harmonics are treated. Much of the convergence theory could, one feels, be cut out with advantage, as it could be supplied by any competent reader, if so desired. In addition, the more elaborate properties of Legendre's polynomials and the associated functions can only be dealt with, satisfactorily, by complex function theory; and one is left with the distasteful impression that, in certain cases, it is only by luck, rather than judgment, that the correct results are obtained by the cruder arguments involving real variables only.

From Chapter 5 onwards, the book becomes infinitely more interesting, and it is in this and the remaining six chapters that the authors have provided a most valuable contribution to mathematical literature. Chapter 5 gives an account of the behaviour of the potential at points occupied by mass and is sufficiently accurate and comprehensive for most ordinary students. A short chapter on the relations of the two-dimensional theory to that of the functions of a complex variable is followed by a very lucid discussion of the boundary value problems of Dirichlet and Neumann, and a proof of the uniqueness of their solution, if it is assumed to exist.

The problems in the case of the circle and the sphere are solved explicitly in Chapters 8 and 9, by means of Poisson's integral; and certain results from the theory of Fourier series, which arise from these, are provided (with proofs where these can be easily supplied). The theory of Green's function is also most adequately dealt with and the existence of this function is shown to be equivalent to that of the mapping function in the fundamental theorem of Riemann, dealing with the conformal representation of any simply connected region with more than one boundary-point on the interior of the unit circle.

In the last two chapters the existence of the solution of both the boundary-value problems (previously quoted) is shown to be equivalent to th existence of a solution of the various types of Fre holm's integral-equation, of which an excelle account is given in Chapter 10.

In spite of having made so much adverse criticis I think there is no doubt that this book will pro to be of great value as a work of reference. It h been provided with a very detailed table of conten and quite a useful index.

J. H. Pearce.

OPERATIONAL CALCULUS

Heaviside's Operation Calculus Made Easy

By Dr. T. H. Turney. Pp. vii+96. (London: Cha man and Hall, 1944.) 10*s*. 6*d*. net.

The Simple Calculation of Electrical Transients

An Elementary Treatment of Transient Problems i Linear Electrical Circuits, by Heaviside's Operation Method. By G. W. Carter. Pp. viii+120. (Cambridge: At the University Press, 1944.) 8*s*. 6*d*. net

CAN any subject be made easy? Did Silvanu Thompson's "Calculus Made Easy" save single headache in the younger generation when i tried to master the mathematical tools of its elders The first of the above books ought to be one which has been long awaited, namely, a graduated introduction to the powerful tool devised by Heaviside. Th colloquial style does not, however, inspire confidence; and the early analogies, for example, that of a battery and condenser, and a general disregard of physica principles in favour of simplifying or grouping mathematical representations, are apt to lead an innocent reader astray. Just interchanging voltages and currents in formulæ simply will not do, even if this bright idea appears to help in simple applications. If the author's deduction (p. 12) that non-proportionality of current and flux in a laminated inductance leads to the idea that "the term inductance has little meaning in any case" were really true, most electrical engineers would be profoundly grateful. Then in two short paragraphs, which seem to have slipped forward, we are suddenly confronted with the properties of p. We soon come, however, to p and j, Helmholtz's circuit law, and Heaviside's unit function. Through partial fractions we are led to the application of Heaviside's expansion theorem to transmission lines, and to the development of the treatment of impulses. Dr. Turney finally compares Fourier and Heaviside integrals. The author is always on thin ice; although we do not expect rigour in an introduction to a difficult subject, at least we expect discipline. Mathematicians will certainly not commend this book.

The second book has a more restrictive title, although covering a similar section of the subject. The author is on much surer ground, needs no flourishes of style, comes much more quickly to the point at issue, holds on to physical aspects of his problems, and states quite clearly his assumptions of knowledge in the reader; his high-grade examples are closely woven into the text. The student is apt to be diffident in the usage of Heaviside's calculus, except in its simplest applications, in which he often knows the answer from more protracted but less intuitive methods; the present book should through its exercises give students that confidence which is the educational stimulus to go further. Perhaps this is the text-book we have been waiting for.

L. E. C. Hughes.

DIRECT CHEMICAL ACTION UPON NERVE CENTRES IN BIOLOGY AND MEDICINE

By Prof. LENA STERN

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IN the course of evolution, as organisms have become more complex, they have also become more sensitive to their internal environment, for example, in higher animals, to the temperature, pH, and osmotic pressure of the blood and lymph. Minute changes in the properties of the internal milieu may result in serious dislocation of the functioning of the organism. As Claude Bernard said: "La fixité du milieu intérieur est la condition de la vie libre".

Local Environment

In addition to the general internal milieu common to all parts of an organism, there has evolved for each individual organ a specialized 'local' milieu, for which we have proposed the name 'immediate' or 'intimate' environment. Each organ derives the materials necessary for its functioning from the cellular fluid forming its local environment; and into this local environment the organism discharges the products of its metabolism. The physical and chemical properties of the fluid which is the local environment of an organ are related to the structure and functions of that organ. Any abnormal change in the composition of this environment leads to a corresponding disturbance in the organ; the disturbance may be so serious as to bring about the death of the whole organism.

The local environment of each organ is separated from the general internal environment by a physiological mechanism to which we have given the name 'histo-hæmatic' barrier. These barriers regulate the exchange between the blood and the immediate environment of each organ; they control the inward passage of substances from the blood stream; they facilitate the discharge from the local environment of the organ into the blood stream of the products of metabolism; they maintain the constancy of the local environment.

It is clear, therefore, that the proper functioning of each organ depends on the integrity of the histo-hæmatic barrier surrounding its local environment. For example, an increase in the permeability of the barrier would expose the organ to any drugs circulating in the blood, which might not be able to penetrate the barrier under normal conditions.

The Hæmato-Encephalic Barrier

The spinal fluid is the local environment of the brain and the spinal cord. We have found that the properties of the spinal fluid depend largely upon the regulating action of what we call the 'hæmato-encephalic' barrier, which comprises the endothelium of the capillaries and the neuroglia. This barrier protects the central nervous system from toxins, virus, bacteria, etc., in the blood stream; it controls the entry of substances necessary for the nutrition of the central nervous system; it allows the passage from the spinal fluid into the blood stream of metabolic products of the brain which would, if they accumulated, disturb the activity of the central nervous system. The hæmato-encephalic barrier possesses selective permeability not only for substances foreign to the organism, but also for various natural products of metabolism, for example, antitoxins, hormones, etc. The permeability is, moreover, asymmetric: there is more selection in the direction blood→spinal fluid than in the direction spinal fluid→blood. This concept of histo-hæmatic barriers (particularly the hæmato-encephalic barrier) has been the basis of our work on the differences between the effects of drugs injected into the blood stream and into the fluid of the spinal cord.

There is a close relation between the permeability of the hæmato-encephalic barrier for any particular substance in the blood, and the possibility of this substance affecting the central nervous system. The only substances which affect the central nervous system when added to the blood are those which penetrate into the nutritional milieu of the brain, that is, the spinal fluid. Other substances which normally produce no neurotropic effect may affect the nervous system profoundly if they enter the spinal fluid. Consequently, when defining the neurotropic properties of a substance, it is necessary to know whether or not the substance has penetrated the hæmato-encephalic barrier, and been admitted to the immediate environment of the nervous system.

It is of considerable theoretical and practical interest that the selective permeability of the hæmato-encephalic barrier is considerably less in new-born animals with an undeveloped brain (for example, dog, rabbit, cat, rat) than in adult animals of the same species. This is probably true, too, for the new-born human being. This view is consistent with two facts: it is known that the substances introduced for therapeutic purposes into the circulatory system of a new-born child have effects quite different from the same substances in an adult; and the peculiar clinical manifestations of some diseases in the child (cramps, high temperature) are consistent with the view that in the child toxic substances present in the blood pass into the spinal fluid much more easily than they do in an adult. It is our view that there is a parallel development of the central nervous system and the hæmato-encephalic barrier, not only ontogenetically but also phylogenetically.

The defensive action of the hæmato-encephalic barrier not only increases during early development; it also varies according to the physiological condition of the organism. In pregnant animals, for example, the permeability of the barrier is easily changed by chemical or physical agents which scarcely affect the barrier in animals which are not pregnant. Animals heavily drugged with alcohol show, in the same way, a much greater sensitivity of the hæmato-encephalic barrier: in such animals even a slight change of temperature affects the permeability of the barrier.

The selective permeability of the hæmato-encephalic barrier safeguards in health the nerve centres against invasion by toxic substances. But in sickness, the barrier may be a hindrance, because it may prevent the penetration of therapeutic substances to the diseased nerve centres. This view is supported by clinical data. We have evidence that the pathological symptoms of the nervous system in some infectious diseases (for example, tetanus, encephalitis) are due to the direct action of the toxin or virus concerned upon the brain. We have evidence, too, that attempts to cure disorders of the central nervous system by the application of therapeutic agents into the blood stream are ineffectual because the barrier prevents the agents from passing into the spinal fluid.

Direct Introduction of Substances into the Spinal Fluid

There are two ways in which a therapeutic agent can be brought into the local environment of the central nervous system: (1) by lowering the resistance of the barrier (by increasing its permeability) and (2) by avoiding the barrier (by introducing the substance directly into the cavity of the cerebral ventricles).

It is possible through changes of temperature, pH, osmotic pressure, etc., to increase the permeability of the hæmato-encephalic barrier. But the clinical value of this treatment is questionable, for the permeability is increased not only to the substance it is required to introduce, but also to any noxious substances and toxins which may be in the blood stream. The second method, of introducing the substance directly into the cavities of the cerebral ventricles, has been intensively studied by us in recent years. We have, for example, introduced anti-tetanus serum into animals suffering from tetanus. In all experiments where the serum was introduced into the circulation, it gave positive results if introduced before the first symptoms of tetanus appeared. In experiments where the serum was introduced into the cerebral ventricles even after the onset of tetanus, the disease was arrested and there was total recovery: provided, of course, that the interval between the onset of symptoms and the time of injection was not too great.

These results secured with experimental animals have been applied successfully to horses suffering from tetanus and have been confirmed by clinical practice. Patients suffering from tetanus have been injected with anti-tetanus serum by cisternal injection. In the great majority of cases, if the injections were applied in time, the patients improved rapidly. This treatment is now being applied successfully in Army hospitals: simultaneously with an intravenous or intramuscular injection, 10–20 ml. antitetanus serum—that is, 15,000–30,000 American units—are introduced by cisternal injection into the cerebro-spinal canal, after removing an equal volume of spinal fluid. The method has recently been applied by Prof. E. M. Steblov, of the Neurological Institute in Alma-Ata, to treat the after-effects of seasonal encephalitis. Twenty-two cases were treated with reconvalescent serum. In only two of these cases, where the syndrome was of more than twenty years standing, did the injections produce no effect. In the other twenty cases there was visible improvement after the fifth injection, and in some patients even some power of movement was restored.

It is possible that the method may be extended to treat successfully other disorders of the brain and nervous system, even by the introduction direct into the spinal fluid of the patient's own blood serum.

Antagonistic Action of Chemicals

The work of O. Loewi and others has shown that nerve action is accompanied by the production of mediators: chemical substances resembling adrenaline and acetylcholine. These mediators have the same sort of action on effectors as direct stimulation by a corresponding nerve; they support and enhance the effects of excitation on the peripheral parts of the vegetative nervous system.

Our experimental results, and others already published, demonstrate that these mediators have a precisely opposite action on the corresponding parts of the central nervous system. They penetrate t hæmato-encephalic barrier from the blood stream the spinal fluid, and there they tend to neutrali the effect they have produced on the periphe system. These mediators, by neutralizing at one p of the nervous system the effects they have produc at the other pole, provide a means of autoregulati in the organism. Their antagonistic effect is shar by humeral agents, too.

The work of a great number of scientific worke indicates that the metabolites of the brain exert similar autoregulating function. Substances produc in the central nervous system (for example, su stances present in blood flowing from the brai affect the peripheral elements quite differently fro the central nervous system. The conclusion can drawn that these chemical substances, by their co trasting action on different parts of the organis play an important part in autoregulation. The brai controls not only by nervous impulses, but also b liberating chemical agents.

Arising out of this antagonism, there is anoth application of the method of direct injection into th spinal fluid, which depends on the fact establishe by us, that the effect of some inorganic substance (for example, salts of potassium and calcium) on th peripheral elements of the vegetative system an their effector organs differs totally from the effec of the same substances on the central nervous system Thus it has been established that an increase in th quotient K/Ca in the spinal fluid increases the tonu of the sympathetic nervous system; but in the bloo the same changes in the quotient K/Ca lead t diametrically opposite results. It is sufficient t introduce a minimal quantity (a few mgm.) of K ions into the cerebral ventricles to call forth a strong excitation of vegetative organs; augmentation o cardiac activity; increase of muscle tonus, metabolism and excitability: all results diametrically the opposite of those produced if potassium is introduced into the blood stream. The same contrast is brought about by certain other materials (metabolites of organs, hormones, mediators, etc.) when applied to the blood on one hand and to the spinal fluid on the other.

Treatment of Shock

Since many pathological states, including vegetative neuroses, are due to changes in the tonus of the sympathetic and parasympathetic centres, or in the relation between the tonus of these centres, the method of direct application of drugs to these centres has considerable clinical possibilities. The results we have obtained in the treatment of shock in the wounded are of particular interest.

The role of the vegetative nervous system in the development of shock has been developed especially by W. Cannon and his collaborators, and it has been confirmed by many other workers and by ourselves. Shock is directly due to changes in the tonus of the nervous system, in particular to the diminution of the tonus of the sympathetic centres following their extreme excitation. An analysis of the spinal fluid in the later stages of shock shows a decrease in the quotient K/Ca, owing mainly to a decrease in potassium. This is accompanied by a spontaneous decrease in inorganic phosphate. These observations lead us to the conclusion that the first task in the treatment of shock is to introduce potassium phosphate directly into the cerebral ventricles in order to restore the K/Ca quotient.

This treatment proved effective on animals. Soon ter the introduction of the solution, blood pressure creases rapidly, respiration becomes deeper, the citability and reactivity of the animal are restored. he injection must be performed as early as possible cause the capacity of the vegetative centres to spond to treatment decreases during shock. Clinical eatment of shock confirms these experiments. The ethod now being successfully applied to war cases to introduce suboccipitally to the vegetative ntres a mixture of mono- and di-potassium phoshates (6·5 mgm. K per ml., with a pH of 7·4–7·5). or clinical treatment the quantity used ranges from to 7 ml., according to the severity of the shock, and r animals, 0·1 ml. per kgm. live-weight. The atient reacts in one or two minutes. It is essential at the material should penetrate the ventricle vity; failure of the treatment is usually due to chnical errors in its administration.

Other Possible Applications

The results encourage us to suppose that the ethod of direct action upon the nerve centres may e effective in the treatment of other nervous disrders. For example, diseases believed to be due o excessive tonus of the parasympathetic system vagotonia) or of the sympathetic nervous system sympatheticotonia) might be treated by introducing nto the cerebral ventricles potassium phosphate in ne case and calcium salts in the other. Promising esults have been obtained by Prof. Y. Y. Sendulsky f Alma-Ata, in the treatment of certain kinds of eafness associated with the vegetative nervous ystem by cisternal injections of potassium phoshate, and for some kinds of dystrophia and chronic epsis, by injection of vitamin B_1.

A further extension of our investigations in recent ears has revealed that certain metabolites of organs for example, the thyroid gland) affect the nervous ystem in a way quite different from their effects hrough the blood stream. There is an interesting field for the study of the effects of other metabolites on the nervous system. It is possible that, by the use of this method of direct injection into the spinal fluid, some diseases of the nervous system hitherto regarded as incurable may yield to treatment.

PHYSICAL AND CHEMICAL DEGRADATION OF RUBBER

ALTHOUGH chemical unsaturation is not essential to the occurrence of 'rubbery properties', all forms of 'rubber' which to-day find extensive application consist of long-chain molecules with frequently recurring ethylenic linkages. Admittedly, the chemical unsaturation may, and does, have adverse influence on the service life of rubber articles, but it also enables the material to be submitted to various forms of chemical treatment for the fuller control of its manipulation during manufacture and for enhancement of the physical characteristics of the manufactured products. Fortunately, the degree of chemical reactivity is so moderate as to permit a practical compromise leaving a large credit balance on the side of mechanical stability and endurance.

It is difficult to dissociate sharply the phenomena associated respectively with the chemical and physical instability of rubber. They have been of very great importance ever since the inception of the rubber industry. The deterioration of some of his early products was a grievous trouble to Charles Goodyear a century ago, and would have daunted a less pertinacious and resilient pioneer. Thanks to his basic achievements in the United States and to those of Thomas Hancock in Britain, supplemented by other discoveries, the rubber industry has made striking advances, and rubber articles are to-day capable of long service under conditions which then would have been deemed quite impracticable.

The recent achievement of the American chemical industries in producing synthetic rubber on a scale commensurate with the pre-war output of the rubber-plantation areas has incidentally necessitated still greater attention to the deliberate and controlled 'breakdown' of rubber; even more than natural rubber, the chief new material, so-called GR–S synthetic rubber, demands plasticization as a preliminary stage in its conversion into manufactured products.

In view of the many-sided importance of the subject and its associated problems, a symposium was held in Birmingham on May 12, on the initiative of the Midland Section of the Institution of the Rubber Industry, to discuss the "Physical and Chemical Breakdown of Rubber". As stated at the symposium by its chairman, Mr. F. G. W. King, technical director of the Dunlop Rubber Co., the magnitude of the contribution of the rubber industry to the allied war effort is difficult to appreciate fully, and the difficulties which have been surmounted are realized only by those directly concerned. Many of these difficulties fall within the range of the subject discussed.

The nine papers submitted revealed the breadth of the research activities of the industry, three contributions being presented by the British Rubber Producers' Research Association, two by the Research Association of British Rubber Manufacturers, two by the Rubber Division of Imperial Chemical Industries, Ltd., and two by the Technical Department of the Dunlop Rubber Co., Ltd.

The first paper to be read gave a preliminary report by Drs. W. J. C. Orr and J. L. Bolland, of the British Rubber Producers' Research Association, on the "Thermal Breakdown of Rubber" observed with comminuted 'sol' rubber, carefully freed from dissolved oxygen. Up to 200° C., the rubber is stable; but at 220–270° C. it shows gradual degradation without substantial loss of unsaturation but with the formation of a small proportion of volatile products, mainly isoprene and dipentene, approximately one molecule of the former and four of the latter being found when the molecular weight of the rubber, by osmotic measurements, has fallen to half its original value. On further heating, the rubber again becomes more viscous and finally sets to a benzene-insoluble, non-sticky solid. This latter change indicates that the degradation mechanism must be complicated by secondary reactions between the intermediate scission products and other molecular chains. By applying the 'resonance' concept and considering the energy of splitting of the chain molecule at the possible points, it is deduced that both the isoprene and dipentene are formed by fission at the ends of the rubber molecule, little if any of the latter arising from dimerization of pre-formed isoprene.

Details of another piece of fundamental research from the Association's laboratories were given by Dr. L. C. Bateman on the "Photochemical Breakdown of Rubber". When finely cut, purified, *Hevea* rubber in an exhausted silica tube is exposed to light from a mercury arc, formation of a small quantity of gaseous products is observed, largely free hydrogen: the rubber concurrently becomes insoluble, with increase in molecular weight and slight decrease in iodine value. From quantum considerations these results are regarded as being in line with those to be expected from the known behaviour of simpler olefines.

The third investigation from the Associations' Laboratories, described by Dr. E. H. Farmer, related to the "Oxidative Breakdown of Rubber". The first stage in the autoxidative process with rubber involves the absorption of whole molecules of oxygen by the rubber, with formation of unstable organic peroxides; decomposition of these may occur in different ways, but, for natural rubber, gives rise normally to chain scission resulting in softening, with loss of elasticity and strength; whereas for synthetic rubbers it tends to result in toughening caused by polymerization or 'oxygen vulcanization'. For the fuller elucidation of the behaviour of the initial unstable peroxidic rubber product, that of various simpler olefine peroxides was also examined and discussed. The thermal and catalytic acceleration of the decomposition of the unstable 'rubber peroxide' are probably highly important factors in the autoxidative degradation of rubber and demand more intensive investigation than they have received hitherto.

The importance of the promoted degradation of rubber as a laboratory 'tool' was emphasized by two papers dealing with accelerated ageing. "The Heat Ageing of GR–S Vulcanisates" by Dr. J. R. Scott, of the Research Association of British Rubber Manufacturers, was one paper, of two only, devoted solely to synthetic rubber. Dr. Scott reported the results of numerous heat-ageing tests in air or oxygen at atmospheric pressure or higher, and gave due attention to the views of other investigators. The alteration in tensile strength, elongation and modulus of the vulcanizates is found to proceed about 2½ times as rapidly for each 10° C. rise in temperature, which is in agreement with earlier estimates. In contrast to natural-rubber vulcanizates, however, the alteration of GR–S vulcanizates with ageing tends to be less the longer the period of vulcanization; the stability of GR–S towards ageing also appears to be favoured by the use of low proportions of sulphur for vulcanization. Oxidation during ageing is capable of a twofold effect, the predominant result normally being stiffening, presumably by oxygen-bridging of the molecules; with severe oxidation of under-vulcanized samples, however, loss in tensile strength may occur in consequence of chain scission. Hycar EP, another copolymer of butadiene and styrene, shows similar heat ageing to GR–S, but with rather better retention of tensile strength at higher temperatures.

The other paper on accelerated ageing, by Messrs. J. M. Buist and G. N. Welding, of Imperial Chemical Industries, Ltd., dealt with the "Use and Misuse of Accelerated Ageing Tests", and gave a careful survey of the aim of such tests and their limitations as an index to the probable behaviour in service. Permanent alteration in the rubber after ageing, according to circumstances, may concern only a thin skin, or a thick surface layer, or the whole mass. These three types of result were discussed in detail, and appropriate accelerated tests, both by heat-ageing and light-ageing, were brought under consideration. The skin effect is commonly associated with the influence of light. Deep surface effects include atmospheric cracking (apparently initiated by traces of ozone) a surface-hardening or -softening by oxygen attack higher temperatures; the hardening or softening, prolonged, may extend throughout the mass. T authors conclude that the processes leading to t breakdown of rubber are too diverse for all to capable of easy or satisfactory reproduction in single accelerated test. Moreover, for the correct u of accelerated ageing tests, a clear understanding the differences between the types of ageing is essent and each such test should, so far as possible, accelera only one process; for example, that affecting t elongation at break, so that it can be studied indepe dently of others.

Three papers contributed to the meeting dealt wi ageing as caused or induced by exposure to 'weathe The first of these, by Mr. H. C. Harrison, of Imperi Chemical Industries, Ltd., on the "Weathering GR–S", confirmed the paper last mentioned, questioning the general applicability of accelerat ageing tests. Contrary to early indications fro accelerated tests, the weathering characteristics GR–S are disappointing; cracks develop in t material when exposed under slight tension, fresh a and increased air circulation being conducive to s intensified effect; light is not a main cause. Ant oxidants give little benefit, and compounding gene ally provides no satisfactory remedy except for t beneficial influence of a small percentage of certa waxes, particularly those with microcrystalli structure, such as beeswax or paraffin wax. Th problem presented by GR–S rubber was considered b the author in detail not only for stout sheets of th material but also for thin 'proofings' on fabrics.

This subject of atmospheric cracking, in its relation to natural and synthetic rubbers, was dealt wit from a wide angle in a concise and comprehensiv paper by Dr. R. G. Newton, of the Research Associa tion of the British Rubber Manufacturers, entitle "The Mechanism of Exposure Cracking". The rat of 'exposure cracking' (a term which the author prefer to 'atmospheric cracking') is found to be proportiona to the ozone content of the air or ozonized oxyge surrounding the rubber. The normal ozone conten of the outside air is sufficient for the purpose, bu inside buildings it is generally too low. Not only does light not produce cracks, but also it frequently prevents their development by giving rise to an oxidized skin which prevents access of the ozone to the actual rubber surface. Strain is necessary as well as ozone, and, in line with some other investigators, the author agrees that a maximum in the severity of cracking, as judged visually, is observed with an elongation of roughly 20 per cent. The occurrence of this so-called 'critical elongation' is attributed to the mutual interference of neighbouring cracks; cracks formed under the lower elongations join up to form longer and more obvious ones, whereas those formed in more highly stretched rubber tend to remain discrete. Exposure-cracking can be prevented by eliminating strains from the rubber, and cable makers are said to adopt more than one device to this end. Waxes capable of forming a continuous surface 'bloom' on the rubber can afford some protection, but if the film is incomplete, or incapable of self-repair when broken by flexing or further stretching, localized attack may arise with worse results eventually than if no wax had been used.

This importance of complete continuity, if a film of wax bloom, or of any coating preparation, is to give useful protection and not intensified deterioraion, was also stressed in a paper by Messrs. E. F. Powell and V. E. Gough, of the Dunlop Rubber Co. Ltd., on "The Mechanism of Rubber Cracking". While challenging the concept of the existence of a critical elongation', these authors agree as to the oarser and more serious nature of the cracks formed at lower elongations than at higher, although the racks are less numerous in the former case. Consideration was given to the statistical nature of the distribution of the cracks, and several practical aspects of the cracking problem were discussed, such as the distribution of stresses at the bottom of grooves or slits in masses of rubber, for example, in tyre reads, and its influence on the location and direction of crack growth. A parallel seems to exist between the relation of the type of cracking to the probability of attack and to the rate of propagation of previously ormed cracks, and the importance of 'probability of attack' and 'conditional velocity' as revealed in metal-corrosion researches.

The last paper of the meeting, on "The Behaviour of Natural Rubber and GR–S under Repeated Stress Cycles" by Dr. D. Parkinson and Mr. J. L. Bloxham, of the Dunlop Rubber Co., Ltd., recorded results obtained with the Dunlop fatigue-testing machine, which has been described elsewhere. Under repeated cycles of stress lasting over considerable periods, GR–S 'compounds' develop higher temperatures than those attained by analogous natural-rubber 'compounds', but under such conditions they will withstand a higher steadily maintained temperature; so that despite the admitted superiority of natural-rubber vulcanizates in resistance to fatigue, its advantages in this respect are less than might be anticipated from its higher tensile- and tear-strength. Incorporation of carbon black in either form of rubber increases the resistance to fatigue, and 'furnace blacks' have a greater effect than 'channel blacks'. For each type of carbon black there is an optimum concentration which is generally greater for compounded GR–S than for compounded *Hevea* rubber.

In terminating the proceedings, the chairman remarked on the successful issue of the gathering, the first all-day symposium in Great Britain to be devoted to a single group of problems of the rubber industry. The potential value of such discussions and interchange of views between research workers is very great. The full papers and subsequent discussions will be made available in the *Transactions of the Institution of the Rubber Industry*. The Institution will no doubt take steps to ensure that further meetings of similar type are arranged to deal with other outstanding problems.

D. F. Twiss.

VITAMIN A DEFICIENCY AND THE REQUIREMENTS OF HUMAN ADULTS

In response to a request from the Ministry of Food, the Vitamin A Sub-Committee of the Accessory Food Factors Committee (Lister Institute and Medical Research Council) undertook an experiment to obtain information on the human requirement of vitamin A and of carotene. The experiment was carried out at the Sorby Research Institute, Sheffield, for the Medical Research Council, by which it was financed. It lasted from July 1942 until October 1944.

Twenty-three 'conscientious objectors', twenty men and three women, volunteered to live on a diet designed to be deficient in these substances but complete in every other respect. The absence of vitamin A and its precursors was confirmed spectrophotometrically and biologically. Young rats fed on the diet grew well when supplied with vitamin A but, without it, failed to thrive and their livers at autopsy were devoid of vitamin A. The disappearance of carotene from the blood plasma of the deprived volunteers confirmed the absence of these substances from the diet. Prophylactic and therapeutic tests were made with vitamin A and carotene, and fæcal excretion tests were made with carotene from different sources. No attempt was made to differentiate between the biological values of different isomers of carotene.

As the experiment lasted more than two years, the results obtained were extensive and cannot quickly be prepared for publication, but, since their implications in assessing nutritional status and requirements in respect of vitamin A are far-reaching, it is important that some of them should be widely known. It has therefore been decided to publish the chief conclusions about which the team of workers is unanimously in agreement. Full details with a discussion of the literature will appear later.

With efficiency for dark adaptation and plasma values for vitamin A as criteria, none of the sixteen deprived subjects became depleted within a year. Eleven of these continued the test for more than thirteen months, and only three showed marked signs of depletion, after fourteen, seventeen and twenty-two months, respectively. Most of the remainder showed no changes attributable to vitamin A deficiency, except a gradual fall in the plasma value for vitamin A, estimated by the antimony trichloride method; but one failed to show this sign of deterioration even after twenty-two months. The state of the vitamin A reserves of this sample of the population of Great Britain in the summer of 1942 would thus seem to have been sufficient to meet the requirements for from one to two years. This conclusion is in harmony with the finding, at about the same period, of a median value of 600,000 I.U. for the total vitamin A reserves of the liver, determined at autopsy, in cases of accidental death.

Signs of depletion. In the three markedly depleted subjects, the value for vitamin A in the blood plasma declined from about 90 I.U per 100 ml. to about 30 I.U. In the test of the capacity for dark adaptation, measured with the Wald-Steven modification of the Hecht-Shlaer adaptometer, the values for the final rod-threshold ranged, at the start, from 1·55 to 1.95 log. micromillilamberts, and rose to between 2·38 and 3·44; at about the same time, the time of transition from cone to rod vision, which was at first from five to ten minutes, increased to as much in one case as thirty-three minutes.

In contrast with the slow fall in the value for vitamin A in the plasma which occurred in almost all the subjects undergoing depletion, the value for total carotenoids fell quickly and remained low. Chromatography of a pooled sample of plasma after nine months of depletion showed it to contain 18 μgm. total carotenoids per 100 ml., but no measurable amount of α- or β-carotene. The value for the final rod-threshold in all the subjects, whether undergoing depletion or not, deteriorated significantly during the first winter, seven months from the start, but, in most cases, recovered in the spring to the initial level.

The explanation of this phenomenon is unknown, but the risk of misinterpretation thus introduced is clearly great. The value did not again deteriorate significantly until much later, when the plasma value for vitamin A had declined to about 40 I.U. per 100 ml. There did not appear to be any correlation between the value for vitamin A in the plasma and the value for the final rod-threshold until both had deteriorated significantly.

Three different laboratories carried out the blood tests, the samples being distributed by post; their results often varied much for the same sample, but the average of a sufficient number yielded consistent results. All three laboratories agreed that no great reliance could be placed on the result of a single estimation for vitamin A in plasma.

From the thirteenth month of the experiment onwards, P. C. Livingston applied his new technique of rod scotometry to examination of the volunteers. By this method the field of vision was mapped under conditions of dark adaptation with test objects of known very low luminosity[1]. The technique confirmed the existence of defective night vision in the three volunteers whose final rod-threshold was raised and cone-rod transition-time lengthened. In addition, this method revealed the night vision as defective in five of the other deprived subjects who gave normal readings with the adaptometers of Craik and of Wald and Steven. On treatment with vitamin A or carotene, the scotometry readings returned to normal. Rod scotometry thus seemed to detect deterioration of capacity for dark adaptation earlier than was possible by measurement of the dark-adaptation curve.

There were no objective changes on general clinical examination, or conjunctival changes perceptible with the slit-lamp microscope; there were no changes in the blood picture or platelet count. Only one subject showed follicular hyperkeratosis, but a study of the case history indicated that the condition was present from the start and was not specifically affected by variations in the vitamin A supply. There were no definite changes in response to memory and fatigue tests. There was no consistent loss of weight.

Absorption tests. A comparison of the dietary and fæcal carotene for the volunteers receiving a carotene supplement showed that the disappearance of carotene from the gastro-intestinal tract was highest when the carotene was dissolved in fat (arachis oil or margarine); on the average, 28 per cent of carotene given in this form was excreted. The percentage excretion of carotene from green vegetables (cabbage or spinach) was in the region of 60, and from sliced carrots in the region of 75. The individual variations were wide.

Requirement of vitamin A and of carotene. Seven volunteers without previous depletion received, for periods of from six and a half to twenty-two and a half months, a daily supplement of about 2,500 I.U. vitamin A as distilled natural esters in oil, or of about 5,000 I.U. carotene, in oil or from various natural sources, and showed no changes attributable to vitamin A deficiency.

The three subjects who developed defective night vision and low plasma values for vitamin A were dosed with vitamin A or β-carotene in oil while the deficient diet continued. In one case treatment with a daily dose of 1,300 I.U. vitamin A restored dark adaptation and plasma vitamin A values to normal levels within five months. A second case did not respond to a dose of 1,300 I.U. carotene daily but improved in the course of five months when the dose was changed to one of 2,600 I.U. daily. In the thi case, where the degree of deficiency was milder, daily dose of 2,600 I.U. carotene promptly improve dark adaptation and the concentration of vitamin in the plasma.

When the amount of carotene excreted wa deducted, the amount of vitamin A and of caroten which brought about the same result would thu appear to be about the same.

For assessing the requirement the relevant result are the following:

A daily dose of 1,300 I.U. vitamin A or of 2,600 I.U carotene was sufficient to *cure* a mild state of vitami A deficiency. The body reserves of vitamin A, pre sumed as already mentioned to have had a media value of about 600,000 I.U., were sufficient in al sixteen deprived subjects to prevent the onset o definite signs of vitamin A deficiency for from twelv to twenty months; such a reserve would correspon with an average rate of consumption of 1,300 I.U daily for fifteen months.

Thus, inclusion in the diet of a daily dose o 2,500 I.U. vitamin A, or of 5,000 I.U. carotene, may be regarded as adequate for maintenance of norma human adults and as leaving a fair margin of safety

The following members of the Vitamin A Sub-Committee, Dr. K. H. Coward, Miss E. M. Hume (secretary), Dr. S. K. Kon, Dr. T. Moore and Prof R. A. Morton, formed part of a team which included Mr. W. C. Bartley, Prof. H. A. Krebs, Dr. K. Mellanby and Dr. J. Pemberton, each of whom undertook responsibilities in Sheffield and, with Mr. T. W. Goodwin, Dr. H. M. Sinclair and Miss C. M. Wood, participated in the work and in the regular meetings concerned with the conduct of the investigation. Many other workers, whose contributions will be recorded in the full report, supplemented the work of the Sub-Committee.

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[1] Livingston, P. C., *Lancet*, i, 33 (1944).

OBITUARIES

Prof. Alexander Fersman

PROF. ALEXANDER FERSMAN, the distinguished Russian mineralogist and geochemist, died on May 20 at the age of sixty-two. The death of his former teacher, Prof. V. I. Vernadsky, a brilliant investigator in the same field, occurred a few months earlier[1]. The double loss is a grievous blow to the science of geochemistry, for both men occupied the leading positions in the vigorous Russian schools of geochemical studies of which a short account was given recently in the pages of *Nature*[2].

For the present notice on Fersman's work, some data have been drawn from a note supplied by Prof. A. Vinogradov, of the Academy of Sciences, Moscow.

Graduating from the University of Moscow in 1907, Fersman first worked in the laboratory of Vernadsky. He was ultimately to become director of the Lomonosov Institute of Mineralogy, Crystallography and Geochemistry in Moscow, a new institute founded in recent years by the fusion of four departments of the Academy of Sciences of the U.S.S.R.

Fersman's early researches were essentially crystallographic and mineralogical: he worked in Paris and Heidelberg and travelled in Switzerland ıd Italy, eventually contributing a paper on the ıineralogy of Elba. He was co-author with V. oldschmidt of Heidelberg of an elaborate memoir a the crystal morphology of the diamond, and later roduced an authoritative treatise on the precious tones of Russia.

In 1912 Fersman was appointed to a professorship ı mineralogy and to a curatorship of the Museum f Mineralogy attached to the Academy of Sciences. 'rom this time his interests were to be devoted to he field of geochemistry. There were to follow during he next twenty-five years his monumental works on eochemistry, and while it is still too early to assess he value of some of the daring theoretical treatment is exuberant genius brought to the interpretation f the factual data, experimental and observational, which he had amassed, his rank as a leader of international reputation has rested on brilliant achievement over a wide field. Between the two World Wars his contributions included detailed investigations on the geochemistry of pegmatites, particularly hose of granite and alkali-syenite type; researches on the geochemical migration of elements within sedimentary terrains remote from magmatic centres, and numerous other studies in regional mineralogy.

Many geological expeditions fostered by the Academy of Sciences within the vast territories of the U.S.S.R. were organized under his leadership, and he personally conducted explorations in Central Asia, the Urals and the Kola Peninsula. These investigations led to highly important economic developments, notably with the discovery of great apatite deposits of magmatic origin in Kola and of large workable deposits of sulphur in the Kara-Kum desert of Transcaspia.

Of Fersman's many achievements, his researches on the great alkali igneous complexes of Khibin and Lovozero in the Kola region rank among the most outstanding. In the elucidation of these unique intrusions, Fersman's own studies were dominant. They have greatly widened our knowledge of the chemistry and mineralogy of alkali magmas and of the conditions controlling the peculiar sodic (agpaitic) type of differentiation.

As director of the Khibin Scientific Arctic Station near Kirovsk, Fersman inspired much of the later work of his younger colleagues in the same field, and it was under their guidance that the participants in the Kola Excursion of the 1937 International Geological Congress were able to appreciate to the full the magnificent pioneer researches linked with his name.

Fersman's most important memoirs, including his works on geochemistry (four vols., 1933–37), pegmatites (1931, 1940) and other studies in regional mineralogy, are in Russian. In English, his "Scientific Study of Soviet Mineral Resources" (1935) provides a succinct account of the planning and development of the mineralogical researches in which he himself played so prominent a part.

In addition to his scientific work—he was author of some five hundred scientific books and papers—Fersman was active in public life. He had a gift for the exposition of scientific knowledge in popular form, and his artistic sense was shown in his articles about chemical elements, minerals and rocks. Member of the presidium of the Academy of Sciences, he was at one time chief editor of its scientific publications.

Fersman was the recipient of a Stalin Prize and was awarded the Order of the Red Banner of Labour by the Soviet Government. Abroad, his honours included foreign membership of the American and British Mineralogical Societies and the award of the Wollaston Medal of the Geological Society of London in 1943.

C. E. Tilley.

[1] *Nature*, 155, 296 (1945).

[2] *Nature*, 154, 814 (1944).

Sir Martin Forster, F.R.S.

The death in Mysore City on May 24 at the age of seventy-two of Martin Onslow Forster has removed from our midst an organic chemist who, prior to 1922, was an outstanding figure in British chemistry. Forster received his early education at Dover Hill House, Margate, and having decided upon a chemical career he entered the Finsbury Technical College, where he received an excellent training under the late Prof. R. Meldola. As was customary at the time, when the opportunities for research in Britain were somewhat limited, he proceeded to Germany, where he worked at Würzburg under Prof. E. Fischer. The debt which Forster owed to him was in some measure repaid by the brilliant memorial lecture which he delivered to the Chemical Society in October 1920. Returning with his Ph.D. degree, Forster in 1894 came under the influence of Prof. H. E. Armstrong, in whose laboratory he worked as the holder of a Salters' Research Fellowship, and so arose a life-long friendship. His tenure of the fellowship was short, since in 1895 he was appointed by Sir William Tilden to a demonstratorship in chemistry at the Royal College of Science, and there followed a period of amazing scientific activity which rapidly placed Forster in the front rank of British organic chemists.

For many years Forster's investigations were confined almost entirely to the chemistry of camphor, on which subject he published more than thirty memoirs under the general title "Studies in the Camphane Series". Many of these are now only of historic interest; but his work on β-bromocamphor and on the oximes of camphor and *epi*camphor are of lasting value, and the latter form a remarkable contribution to stereochemistry. In 1907, he broke new ground when, in collaboration with H. E. Fierz, the first of a long series of papers on the triazo-group appeared. This work, which was not devoid of personal risk and actually resulted in grievous injury to one of his research students, was actively pursued until 1913, when he resigned his appointment at the Royal College of Science, having been an assistant professor since 1902. Almost all Forster's papers were communicated to the Chemical Society, and they are notable for the clarity and brilliance of their exposition. This latter quality was not confined to the written word, since it was generally regarded as a 'field-day' when Forster read a paper at one of the Society's meetings.

Forster's resignation and his decision to enter politics somewhat surprised his friends, and was undoubtedly due in part to his disappointment at not having been appointed to a full professorship. The outbreak of the War in 1914 brought Forster back to chemistry and in 1915 he was appointed a director of British Dyes, Ltd., a post which he held until 1918. In these critical years he served British chemistry well. His activities were not confined to the technical side of the industry; he was mindful of the importance of social amenities for the staff, being responsible for the first staff club at Huddersfield. During 1918–22 he filled the newly created post of director of the Salters' Institute of Industrial Chemistry, where his experience both as a teacher and in industry undoubtedly proved of the greatest value. His keen interest in the City of London Companies was further shown by his election in 1919 as prime warden of the Worshipful Company of Dyers.

Although so actively engaged in experimental research, Forster found the time to participate in the administration of the Chemical Society. After serving on the Council, he was honorary secretary during 1904–10, treasurer 1913–22 and vice-president 1910–13. The value of his contributions to science were recognized by the Society in 1918 by the award of its highest distinction, the Longstaff Medal. He was elected to the Royal Society in 1905 at the unusually early age of thirty-three, and he served on the Council. He was a regular attendant at the meetings of the British Association, being president of Section B at the Edinburgh meeting in 1920.

A complete change in Forster's life and one made at considerable personal sacrifice came in 1922 when, at the request of his friend Sir William Pope, he accepted the post of director of the Indian Institute of Science, Bangalore. The Institute, which we owe to the munificence of the Tata family, had passed through a somewhat difficult period, and it was clear that if it was to fulfil the hopes of its founders, a director of outstanding quality was required. This it found in Forster, and perhaps in the Institute will be found Forster's most lasting contribution to science. Not only did he win the loyalty and friendship of his staff, but he gained also the confidence and affection of the students. He and Lady Forster, whom he married in 1925, realized to the full their many difficulties. Their hospitality was boundless, and the Institute became a very happy family. His success as a director was due not only to his scientific attainments. He was a fine speaker, and he delighted in the social obligations which his position involved. No one will question that the high position which the Institute has now attained in India is due in large measure to the work which he did.

The many administrative duties of his post prevented Forster from continuing his scientific work in Bangalore, although for the first few years he did direct the work of some research students. But his interest in science never abated, and I personally owe much to his advice and encouragement. He was president of the Indian Science Congress in 1925 and he was an original fellow of the National Institute of Sciences. On his retirement in 1933, Forster settled in Mysore City, making occasional visits to Britain, the last being in 1939. After Lady Forster's death in 1941, his life was somewhat lonely, and he had every intention of returning permanently to London at the end of the War. He had hoped to enjoy once more the scientific life in which he had once played so prominent a part.

J. L. SIMONSEN.

Prof. John Borg

THE death, on May 4, is reported of Prof. John Borg, the most renowned of Maltese botanists. He was formerly superintendent of agriculture, professor of natural history in the University, and director of the Botanic Garden in Malta. From these official posts he retired in 1933; but up to his death he maintained his interests in botany and agriculture, and he held the title of emeritus professor of natural history in the Royal University.

Borg's contributions to the advancement of biolog were varied and included research in both the pu and applied fields. His influence on education wa not limited to his academic activities but extende to public lectures and to articles in the local Pres and other publications written in English or Maltese In agriculture and horticulture, his work include published accounts on the cultivation and diseases o fruit trees in the Maltese Islands, on orange cultur on vines, on scale insects, and on the pig. His boo "Cacti. A Gardener's Handbook for their Identification and Cultivation" (London: Macmillan and Co. Ltd.) is well known and widely used.

The most valuable of Borg's works in systemati botany, and one that will maintain his name amon all interested in the flora of the Mediterranean region is his "Descriptive Flora of the Maltese Islands including the Ferns and Flowering Plants" (Malta Government Printing Office, 1927). This is a boo of 846 pages written in English. It includes a luci introduction to the history of botanical investigatio of the islands, their geology, vegetation and flora The bulk of the volume consists of carefully prepare descriptions of the families, genera and species of th vascular plants, including those naturalized or commonly cultivated, of Malta and the associate islands, together with their Maltese localities an Maltese and English names. The flora gives th impression not only of conscientious preparation bu also of intimate personal acquaintance with the plant described. Malta is intensively cultivated over muc of its surface and almost all the rest is heavily graze (if grazed be the right word) by the almost omnivorou goats, and there is little natural vegetation left; but its flora is surprisingly rich and of considerable importance in studies of the phytogeographica problems of the Mediterranean Basin.

I met Borg only once, in his department in the University of Valetta, and recall him as a quiet, unassuming man devoted to his work but with the widest interest in all that related to his country. His widow, to whom his "Flora" is dedicated and who was his constant companion and assistant on botanical rambles, survives him. His large collection of cacti and other succulents has been left to the Argotti Botanic Gardens and he has made other bequests to his University.

W. B. TURRILL.

Prof. E. Rádl

SOME time in May 1942, Dr. Emanuel Rádl died in Prague at the age of sixty-nine. In early life he was a biologist of local distinction. His critical abilities first reached a wider public in 1909 when he published his "History of the Development of Biological Theories", in which he stressed the changes that had occurred with regard to the significance and the evidence for evolution during the nineteenth century. He was critical of certain Continental schools of biological thought and of various 'cell theories', of temporary 'fashions' in science and of Driesch's ideas on entelechy.

Later Rádl turned his attention to philosophy, changing his chair of biology for that of philosophy at the University of Prague. He wrote several works on the history and modern trends of philosophy, and in his "Present State of Philosophy and Psychology" (1933) he expressed the opinion that Anglo-Saxon countries were then "being infected with the bacilli of moral anarchy, spiritual decadence and cold tellectualism. . . . Who knows how much of our nfusion is due to the fact that England has ceased be the spiritual backbone of Europe ?"

For Rádl the real, the ultimate issue of our life nd our civilization was the problem of whether there an irresistible guarantee and vindication in our earch for truth, whether there is an unshakable inge on which all our ideas, definitions and standards evolve. Rádl was critical but not pessimistic; ndeed, he disliked and attacked the pessimism of swald Sprengler and others. The philosophy of eterminism and nihilism was "one of cowardly bdication and of miserable irresponsibility", but ven in his own country Rádl met with considerable pposition. In 1935 he showed signs of physical fatigue, and it is clear that he foresaw the oncoming catastrophe. He never recovered and the circumstances of his last years hastened his end.

G. Druce.

We regret to announce the following deaths:

Sir Peter Chalmers Mitchell, C.B.E., F.R.S., secretary of the Zoological Society of London during 1903–34, on July 2, aged eighty.

Mr. F. Oates, O.B.E., chief geologist in Tanganyika Territory, on June 10, aged fifty-six.

Dr. H. C. Redeke, the well-known Dutch authority on hydrobiology and fishery research, on April 10.

NEWS and VIEWS

National Physical Laboratory for India

The committee appointed by the governing body of the Council of Scientific and Industrial Research, India, in February 1943, to prepare a scheme for the establishment of a National Physical Laboratory for India has now issued a tentative report setting out the scope of the proposed laboratory, and the staff, equipment and finances required to establish it. Such an institution is regarded as of fundamental importance both for the development of scientific research and for the promotion of organized industries in India, which possesses no metric, electrical, optical or other physical standards which can claim statutory acceptance or scientific precision. The National Physical Laboratory, Teddington, has served as the model for planning an Indian National Physical Laboratory, which as envisaged by the committee will consist of eight sections: weights and measures; applied mechanics and materials; heat and power including low-temperature work; optics (including spectroscopy and photography); electricity (including magnetism, X-rays and radioactivity); radio, sound and electro-acoustics; building and housing research; and shipbuilding and navigational research. Separate institutions for aerodynamics and metallurgy are to be established in India, and accordingly such sections are not included in the proposed Laboratory.

Besides standardization work, the proposed Laboratory should undertake investigations relating to the survey, standardization and processing of primary resources and also fundamental research, and will provide facilities to university teachers for research during the vacations and also to research workers engaged in industry. It will serve as a vital link between the universities and industry. The proposed scheme contemplates the establishment of a Central Specifications Board modelled on the American Federal Specifications Board, which will undertake the formulation of specifications with the aid of the National Physical Laboratory in India and in consultation with consumers, producers and other interests. The report contemplates special grants for pilot plant and emphasizes the importance of having a fully equipped laboratory from the commencement. The emphasis is placed on equipment as much as on the permanent staff or its work, for the Committee considers that a central research station, partly or wholly supported by the State, should be in a position to help any industry requiring facilities for solving problems of immediate interest, besides serving as a repository of general knowledge and carrying out long-range research which will ultimately benefit the whole of industry.

United Nations Relief and Rehabilitation Administration: European Agriculture

The importance of an early improvement in the food situation in Europe is stressed by the inclusion of an agricultural rehabilitation officer in every mission sent by the United Nations Relief and Rehabilitation Administration to the continent of Europe. Missions have been at work for some time in Greece and have more recently entered Jugoslavia and Czechoslovakia; another is preparing to leave for Poland. A special observer has been sent, at the request of the Dutch Government, to Holland. At the first council meeting of the Administration, the organization was charged with the duty of assisting governments in liberated areas in providing the supplies and service needed to enable farmers to sow and harvest essential crops, maintain dairy herds and rehabilitate farms. To this end the Administration may help in re-establishing experimental stations and essential agricultural institutions, organizations and services. The rehabilitation of fisheries is also within the scope of the Administration's activities. Its assistance has already been requested for the re-equipment of veterinary laboratories in Czechoslovakia, Jugoslavia and Poland, and of the Marine Biological Institute in Greece. It is also pressing for immediate facilities to be granted to the International Office of Epizootics in Paris for the resumption of its valuable work in collecting and disseminating information on the occurrence and spread of epizootic disease, and in general on animal health and the means of preserving it. One of the duties of the agricultural officers of the Administration is to inquire into the state of agricultural, scientific and technical research in the country to which they are accredited, and to suggest where a study of results already obtained in the free world, or possibly the visit of a British or American specialist, might help in the solution of local problems.

National Parks in the United States

The National Park System of the United States appears to be in a healthy and progressive state. A review of its position in recent years is contained as one section in the Annual Report of the Secretary of the Interior for 1944 (Washington, D.C.: U.S.

Printing Office. 45 cents). Rather less than one per cent of the total continental area of the United States comes under the care of the National Park System. In 1944 several small additions were made, but the only one of considerable size was in Texas, and the one of most interest was the home of F. D. Roosevelt, which was classed as a historic site. There were war-time difficulties to be faced. Two parks in particular were threatened by economic needs. A threat to the Sitka pines in the Olympic National Park, which were wanted for aircraft production, was averted by supplies from British Columbia and by the increased production of aluminium. Red spruce and hemlock of the Great Smoky Mountain Park were spared by alternative supplies for paper-making being found. Drought conditions in the spring of 1944 raised a demand for the Californian parks to be opened to cattle grazing, but the Parks Committee, after a full inquiry, did not feel justified in granting the request. The demand, however, is to be renewed. In spite of war conditions, the national parks have remained open to visitors and have been much frequented.

Map of British Isles

A COLOURED map of the British Isles, designed to illustrate several aspects of their geography, has been published as a reprint from a Polish volume compiled under the editorship of Dr. Z. Holub-Pacewicz (Glasgow: Księżnica Polska). A brief commentary and the legend, both in English, explain the chief features. The small scale, 1 to 3,000,000, limits the amount of detail and necessitates many generalizations. Perhaps the most noteworthy feature is the analysis of the structure and relief of the coast-line. Eight different types of coast-line are indicated by different colours and symbols. Surface relief is shown by layer colouring, and a few names are given, but, except for the scarps of the south-east, there are no indications of structure. The more important towns are shown with indications of size, but there seems to be a little confusion in the use of the term 'conurbation'. Lost towns in plenty are indicated off the East Riding coast and a few off the Lancashire coast, but none elsewhere. The chief railway lines are marked. The notes accompanying the translated commentary include references to suitable reading, so that the book should help to achieve its object of giving Poles some idea of Great Britain.

Protection of Timber against Powderpost Beetles

ALL who have had anything to do with timber in tropical or semi-tropical regions will have become acquainted with the work of certain boring beetles, or powderpost beetles as they have been termed, of the family Bostrychidæ; posts and sawn timber of most broad-leaved trees are liable to severe damage. The chief damage is done by the larvæ feeding on the sap wood, as is well known. Research and experiments have been carried out in more than one part of the world, with the view of discovering some cheap and practicable method of protecting wood from this type of pest. In leaflet No. 69 (Entomology) of the Forest Research Institute, Dehra Dun, preliminary tests of two methods of protecting timber are dealt with. They are intended to give temporary protection when more standard treatment such as impregnation with preservatives cannot be applied because of lack of plant or material. A mixture of creosote and fuel oil, applied externally, definitely prevents attack for at least nine months and probably longer. A coating of lime gave complete protection over a period of three months when liability to attack was most serious. It is expected that provided the coating is kept intact, protection will be permanent. In each case, it is emphasized that treatment must be applied within a short period of cutting or sawing.

Fluorescence Microscopy of Tubercle Bacilli

Aparato Respiratorio Y Tuberculosis (9, No. 4, Oct.–Dec. 1944, published in Santiago De Chile) has a paper with the title "La Microscopia Fluorescente En La Investigacion Del Bacilo Tuberculoso" contributed by Dr. B. Juricic, Sr. Nicolás Vuskovic, Drs. Gastón, González, Hernán Durán, and Hipólito Vergara In this they describe the results of their investigation of 5,044 cases in which samples of expectoration and gastric contents over a period of a year and a half were examined by the fluorescence microscope. The accessories utilized for transforming the microscope into a fluorescence type were those manufactured by the Spencer Lens Co., Buffalo, and consist of an electric bulb of low voltage and high amperage, provided with a blue-violet filter, and in addition, of an aluminized mirror with a yellow filter for the eyepiece. A monocular microscope was found more satisfactory than a binocular, the number of prisms in the latter considerably diminishing the fluorescence. The results are shown in two tables and a third supplies comparative figures for the Ziehl-Neelsen method. The advantages of the fluorescence method are obvious from this comparison; 52 per cent greater positive results being obtained than with the Ziehl-Neelsen method. In addition, less time is spent in staining the specimens, there is greater rapidity in the examination, and the use of oil immersion is avoided. It is claimed that the fluorescence microscope has a brilliant future before it and that its efficiency is susceptible of great improvement in various ways.

An Electrical Moisture Meter

IN a paper read on April 20 before the Institution of Electrical Engineers in London, Dr. L. Hartshorn and Mr. W. Wilson first outline the purpose which moisture meters are intended to serve, and the various types which have already been described, and then describe the development and construction of a new type of meter that has already been put to good use in several industries. A constant alternating voltage is applied to a sample of the material contained in a small vessel, which may be regarded as a fixed air condenser, or in some instances as a conductivity cell. The current passing through the material is measured by means of a sensitive thermionic ammeter of special construction, which can be adjusted to read the capacitance current, proportional to the dielectric constant of the material; the conductance current, proportional to its A.C. conductivity; or some function of both these currents. The current selected is that which shows the most favourable variation with moisture content. The use of the meter for testing seeds and grain, dried foods and flax straw is discussed, and typical results are given, together with a brief outline of other applications.

Determination of Time Corrections

THE Astronomical Institute of the Academy of Sciences of the U.S.S.R. has issued an "Ephemerides for the Determination of Time Corrections by Equal ltitudes (Zinger's Method) for 1944". The method mployed is similar to that used for 1941, a description f which appeared in *Nature* (153, 29; 1944). The orresponding volume for 1945 has also been received.

"Annuaire Astronomique de l'URSS pour l'An 944", published by the Astronomical Institute of he Academy of Sciences of the U.S.S.R., has been eceived at *Nature* office. It follows the usual proedure, giving the spherical and rectangular co-rdinates of the sun for each day referred to the ean equator and equinox of 1944.0 and 1950.0, he right ascension and declination of the moon and lanets, mean places of stars, 1944.0, etc., with an xplanation at the end in which references are made o various pages of the volume; a brief outline of he formulæ and methods of computation employed s given.

mperial Chemical Industries Fellowships at Cambridge

THE following candidates have been elected to mperial Chemical Industries Fellowships at Cambridge, the subject of research being indicated in brackets: *Physics:* Dr. C. J. Birkett Clews (analysis by X-rays of the structure of conjugated monomeric ydrocarbons at low temperatures, and of the structure of highly polymerized and allied compounds); Dr. M. F. Perutz (structure of crystalline proteins and related substances by X-ray analysis); Mr. M. Ryle (radio physics). *Chemistry (Physical, Inorganic and Organic):* Dr. J. N. Agar (mechanism of electrochemical oxidation and reduction); Dr. J. Baddiley (chemistry of nucleotides); Dr. K. Bailey (studies on cytoplasmic nucleoproteins and nucleic acids); Dr. P. Johnson (investigation of macromolecular systems by gravitational and diffusion methods). *Engineering:* Mr. A. H. A. Hogg (plasticity).

Institution of Electrical Engineers Awards

THE Council of the Institution of Electrical Engineers has made the following award of premiums for papers read during the session 1944–45, or accepted for publication: Group A. *Kelvin Premium:* Mr. G. F. Shotter; *John Hopkinson Premium:* Mr. R. J. Halsey. Group B. *Non-Section Premiums:* Mr. H. Frohlich (Ayrton Premium), Mr. G. A. Juhlin (Llewellyn B. Atkinson Premium), Dr. R. Pohl (Extra Premium). *Installations Section Premiums:* Mr. R. O. Ackerley (Crompton Premium), Mr. R. T. Lythall (Swan Premium), Mr. L. S. Atkinson (Extra Premium). *Measurements Section Premiums:* Dr. L. Hartshorn and W. Wilson (Silvanus Thompson Premium), Mr. D. J. Desmond (Mather Premium), Mr. H. J. Josephs (Extra Premium). *Radio Section Premiums:* Prof. Willis Jackson and Mr. J. S. A. Forsyth (Duddell Premium), Dr. K. R. Sturley (Ambrose Fleming Premium), Mr. D. G. Fink (Extra Premium). *Transmission Section Premiums:* Mr. D. B. Irving (Sebastian de Ferranti Premium), Messrs. W. Kidd and E. M. S. McWhirter (John Snell Premium), Mr. R. C. Hatton and Dr. J. McCombe (Extra Premium), Mr. J. L. Carr (Extra Premium). Group C. *Fahie Premium:* Messrs. R. B. Armstrong and J. A. Smale. *Paris Exhibition, 1881 Premium:* Messrs. L. J. C. Connoll, O. W. Humphreys, and J. L. Rycroft. *Overseas Premium* (for senior members): Mr. R. H. Paul. *Students' Premiums (value £10):* Mr. W. M. Butler, Mr. G. B. Downham, Mr. J. R. Hanchett, Lieut. L. B. Knowles, Mr. J. Willis. *Students' Premiums (value £5):* Mr. J. Banks, Mr. H. Burton, Mr. T. E. Calverley, Mr. J. B. Higham, Mr. A. C. Robb, Mr. W. B. Robertshaw.

Thomas Gray Memorial Trust

THE Council of the Royal Society of Arts offers a prize of £50 and an award of £50 under the Thomas Gray Memorial Trust, the objects of which are "The Advancement of the Science of Navigation and the Scientific and Educational Interests of the British Mercantile Marine". The prize is open to any person of British or Allied nationality for an invention, publication, diagram, etc., which is considered to be an advancement in the science or practice of navigation, proposed or invented by himself in the period January 1, 1940–December 31, 1945. Competitors must forward their proofs of claim between October 1 and December 31, 1945, to the Acting Secretary, Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2.

The award of £50 is made to a member of the British Merchant Navy for any deed which is of outstanding professional merit. The period to be covered by the offer will be the year ending September 30, 1945, and the judges will consider their decision on or after January 1, 1946.

Travelling Fellowships in Medicine

THE Medical Research Council announces that preliminary arrangements have been made for the resumption of Rockefeller Medical Fellowships, to be provided from a fund entrusted to the Council by the Rockefeller Foundation of New York. These fellowships are intended for graduates resident in Great Britain who have had some training in research work in clinical medicine or surgery, or in some other branch of medical science, and are likely to profit by a period of work at a centre in the United States or elsewhere abroad, before taking up positions for higher teaching or research in the United Kingdom. It is hoped it may be possible to make a limited number of awards during the academic year 1945–46, depending on the availability of candidates and facilities for travelling.

Announcements

AT Oxford on June 28, the honorary degree of D.C.L. was conferred on Sir D'Arcy Thompson, professor of natural history in the University of St. Andrews.

The Osler Medal for 1945 has been awarded to Dr. C. G. Douglas, University reader and demonstrator in general metabolism.

MR. N. B. KINNEAR, deputy keeper in the Department of Zoology of the British Museum (Natural History), has been appointed keeper in succession to Mr. M. A. C. Hinton, who retired on June 29.

THE Jones-Bateman Cup is offered triennially by the Royal Horticultural Society for original research in fruit culture which has added to our knowledge of cultivation, genetics, or other relative matters. Particulars can be obtained from the Secretary of the Society, Vincent Square, Westminster, London, S.W.1.

REFERENCE was made in *Nature* of June 23 (p. 764) to the Association of Special Libraries and Information Bureaux, but an old address was given; the present address of the Association is 52 Bloomsbury Street, London, W.C.1.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Individual Hæmoglobins

It has been known for a long time that whereas living tissue can be successfully transplanted from one site to another in an individual animal, transplantation from one individual to another of the same species does not succeed[1,2]; it has been shown that the red blood corpuscles of individual cattle[3] and fowls[4] can be distinguished from one another by immunity reactions; and it has been pointed out that every individual of a sexually reproducing species is genetically different from every other individual, except in the case of identical twins[5]. Such phenomena must depend upon chemical differences between individuals, particularly between their proteins, and in point of fact differences have been found between the hæmoglobins of individual animals.

Several workers, in analysing the globins of mammals, have reported differences between individuals[6]. C. G. Douglas, J. B. S. Haldane and J. S. Haldane[7] showed that the relative affinity for carbon monoxide and oxygen of the bloods of individual mice differs, and this implies hæmoglobin individuality. Anson, Barcroft, Mirsky and Oinuma[8], using the Hartridge reversion spectroscope, found individual variations in the span (that is, the difference between the wave-length of the axes of oxy- and carboxy-hæmoglobin α-bands) for rabbit, mouse and horse; these differences (not given in the text, no doubt since they were not pertinent to the main research, but deducible from their Fig. 6) again mean individually different relative affinities for carbon monoxide and oxygen.

Using the Hartridge instrument, I have lately determined the axial wave-length of the α-band of oxyhæmoglobin in a number of earthworms and frogs without finding any individual variation within the species, but all of four individual rabbits studied were found to be different from one another. The two most diverse, which were of the same sex, age and colour, differed by 3 A. To be certain that the difference was not due to plasma, red corpuscles were suspended in saline and centrifuged before being laked in distilled water, but the result was unchanged. Measured again with fresh blood a fortnight later, the result was still the same. Since individual rabbits thus have visibly different hæmoglobins I looked next for the same phenomenon in human beings. With the view of getting the greatest differences, if there were any, I studied a West African Negro, a Chinaman, a Chinese woman, an Austrian Jew, an Englishwoman and myself. In all these cases the oxyhæmoglobins were identical as regards the wave-length of the α-band.

The Hartridge spectroscope, with which the axis of the oxyhæmoglobin α-band can be measured to one Ångstrøm unit with an error of about one unit on either side, is a very delicate instrument, and a number of precautions are essential in using it. The apparent wave-length varies with the intensity of absorption; it is therefore necessary each time to use the same blood concentration, which may be matched spectroscopically with a standard dilution of human blood. Successive measurements are seldom identical; in my work, series of ten measurements were therefore made and the mean taken. Th calibration of the instrument varies very slightl from day to day, however carefully it is handled this may perhaps be due to temperature or to change in the observer's eye, but, whatever the cause, th calibration of the instrument should be checke whenever it is used and this can be done quite simpl with the 5853 neon line, which is near the oxyhæmoglobin band. The results of Litarczeck and Dinschiotu[9] with human blood are so strange that I ca only ascribe them to spectroscopic errors. These authors used the Hartridge instrument but sa nothing of precautions such as I have just enumerated They found that seven normal human beings had fiv different oxyhæmoglobins, the extremes of which were 8 A. apart, and five anæmic subjects ha four oxyhæmoglobins with extremes 23 A. apart Moreover, in the course of three months the wave-length changed in one individual by 10 A.

I thought it so important to establish beyon doubt the reality of the difference between my extreme rabbits, a difference not far from the experimental error, that instead of taking only ten readings I took seventy with each blood. It is undesirable t take more than twenty readings at a time as the ey becomes fatigued and the readings scattered, and fo this reason I rested after every twenty readings which were taken in alternate groups of five readings with each blood. Moreover, half the measurements were made on one day, half on the next day with fresh blood. The means and standard errors for the two rabbits were 5771·9 ± 0·2 and 5775·2 ± 0·2 Ångstrøm units, the difference between 5772 and 5775 being thus statistically significant and the reality of visibly different individual oxyhæmoglobins established. It would be of interest to know if such differences are genetic.

H. Munro Fox.

Bedford College,
University of London.
May 2.

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[3] Todd, C., and White, R. G., *Proc. Roy. Soc.*, B 84, 255 (1911).

[4] Todd, C., *Proc. Roy. Soc.*, B, 106, 20 (1930)

[5] Mayr, E., "Systematics and the Origin of Species" (New York, 1942)

[6] Roche, J., "Essai sur la biochimie . . des pigments respiratoires" (Paris, 1935).

[7] Douglas, C. G., Haldane, J. B. S., and Haldane, J. S., *J. Physiol.*, 44, 275 (1912).

[8] Anson, M. L., Barcroft, J., Mirsky, A. E., and Oinuma, S., *Proc. Roy. Soc.*, B, 97, 61 (1924).

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A Sympathomometic Pressor Substance in Animal Organ Extracts

During a quantitative study of the piperidine content of various animal organs, following the identification of this substance as a normal constituent of urine[1], it was observed that most organs contain considerable amounts of a pressor substance different from piperidine.

The active substance was obtained by continuous fluid extraction with ether of extracts of the following organs: liver, spleen, kidney, heart, lung, voluntary muscle, smooth muscle (intestine), brain, pancreas, testis. No pressor activity was found in extract from human placenta. As a rule, the pressor action was preceded by a fall of short duration in blood pressure on intravenous injection in the cat.

A preparation with a pure pressor effect was obtained when the ether solution used to remove fats and lipoids from the organ extracts was extracted with a 10 per cent sodium sulphate solution. After removal of the inorganic salts by precipitation with alcohol, the activity corresponded to about 0·1–0·5 μgm. adrenalin per gm. of fresh tissue in spleen extracts. Further yields were obtained by repeated extraction of the organ extract with the ether solution of lipoids and extraction of this solution with a salt solution. In the remaining primary organ extract the biological action corresponded to 2–10 μgm. adrenalin per gm. of fresh tissue.

The active pressor substance is dialysable and readily soluble in water and alcohol and also to some extent in a mixture of alcohol and ether. It is quickly destroyed by heating in normal alkaline solution, but is relatively stable to acids.

The biological actions of the purest preparations so far made are as follow: a rise in blood pressure of the cat in chloralose anæsthesia, enhanced by cocaine and reversed by ergotatime; inhibition of the isolated rabbit's intestine and the non-pregnant uterus of the cat after atropine, and stimulation of the isolated rabbit's uterus, and the frog's heart.

The biological reactions point to a sympathomometic substance, and one is led to consider its relation to the "*sympathicusstoff*" of Loewi. The active extracts give colour reactions with ferric chloride of a similar kind to adrenalin and a strong Folin-Cannon-Denis' reaction with phosphotungstic acid. It has not been possible to obtain the colour reaction with iodine, however, though added adrenalin readily gave this.

U. S. v. Euler.

Physiology Department,
Karolinska Institutet,
Stockholm.
April 16.

[1] Euler, U. S. v., *Nature*, 154, 17 (1944); *Acta Physiol. Scand.*, 8, 380 (1944); *Acta Pharmacol. Scand.*, 1, in the press (1944).

Presence of Reddish Pigment in Eggs and Ovarioles of the Desert Locust, and its Probable Phase Significance

I noticed some time ago that in the desert locust, *Schistocerca gregaria* (Forskål), several eggs had a reddish tinge owing to the presence of pink pigment superficially on the egg-chorion, while others lacked this pigment. Generally, in an egg-pod all the eggs are either pink or non-pink, though exceptionally both kinds may occur in the same pod. Hatchings from some 185 pink eggs (from five different egg-pods) and 406 non-pink eggs (from ten different pods) gave the following kinds of first-stage hoppers: (*a*) Pink eggs: 54 per cent *gregaria* (black pattern), 22 per cent intermediate and 24 per cent *solitaria* (green); (*b*) non-pink eggs: 25 per cent, 17 per cent and 58 per cent respectively. These proportions suggest that pink eggs produced a majority of phase *gregaria* hoppers, though it must be mentioned that hatchings from five pods (172 eggs) were contrary to this suggestion.

I also noticed that in some adult females the ovaries have, at the base of many ovarioles, a mass of orange-red pigment lying in the small basal follicle or pedicel which connects the ovariole proper with the egg-calyx. This pigment was found in both *solitaria* and *gregaria* adults and in both 6- and 7-eye-striped individuals (Roonwal[1]), but was absent in fourth- and fifth-stage hoppers. It was also observed in adults of the rice grasshopper, *Hieroglyphus nigrorepletus* Bol., from a *microptera*. The fact that both the egg and ovariole pigments are soluble in acetone and acetic acid, weakly soluble in absolute alcohol, and insoluble in water, 40 per cent formaldehyde and glycerine, suggests their close similarity. Presumably the ripe eggs, while passing through the pedicel during oviposition, become invested with the reddish pigment.

Pink-red pigments play a considerable part in the desert locust. Künckel d'Herculais[2] first noticed it in the body-wall of young adults from swarms, while Johnston[3] showed that the pink occurs only in the *gregaria* phase, the *solitaria* adults not acquiring it at any stage. Chauvin[4–8] has further studied the adult pigments and also shown that a red pigment is ejected with the excreta. In *Locustana* and *Locusta* Faure[9] has suggested the presence of a hypothetical substance, *locustine*, which is responsible for phase production and which can be transmitted from one generation to the next through the medium of the egg-substance. In view of the similarity, as shown above, of the reddish pigment of eggs and ovarioles, the suggestion may be made that this pigment is connected with Faure's *locustine*.

Full results will be published elsewhere.

M. L. Roonwal.

Zoological Survey of India.
March 8.

[1] Roonwal, M. L., *Curr. Sci.*, 5, 24 (1936).

[2] Kunckel d'Herculais, J., *Ann. Soc. Ent. Fr.*, Paris, 64, xxv (1892).

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[4] Chauvin, R., *Bull. Soc. Hist., Nat. Afr. N.*, Algiers, 29, 249 (1938).

[5] Chauvin, R., *C.R. Acad Sci.*, Paris, 207, 1018 (1938).

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[7] Chauvin, R., *C.R. Soc. Biol.*, Paris, 131, 31 (1939).

[8] Chauvin, R., *C.R. Soc. Biol.*, Paris, 132, 397 (1939).

[9] Faure, J. C., *Bull. Ent. Res.*, London, 23, 293 (1932).

'Palolo' Worms in Pacific Waters

Commander Burrows' interesting letter[1] on the palolo worm prompts me to confirm his assumption that this annelid occurs elsewhere than in Fijian and Samoan waters. It exhibits a similar periodic rising at three points off the coast of Ulawa Islands in the Solomons, where its name is 'orku'[2], and it has also been observed from southern Espiritu Santo in the New Hebrides[3]. Specimens which I sent to the British Museum in 1936 from Ulawa were identified by Mr. C. C. A. Munro as *Eunice viridis* Gray, and this is clearly the same as the *Eunice virida* of Commander Burrows.

In Fiji the mbalolo was reported from Vanua levu as long ago as 1936[4], so that this can be added to Ovalau and the Yasawas. As a matter of interest, a resident on Ovalau recently reported[5] that no worms were recorded at Tokou in 1943; but they were seen in the Yasawas and at Savusavu, Vanua levu, in October and November 1943.

R. A. Lever.

Fiji Club, Suva, Fiji.
March 20.

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[2] Lever, R. J. A. W., *Trop. Agric.*, 20, 2, 42 (1943).

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[4] Robinson, A., *Pacific Islands Mnly.*, August 19, 1936.

[5] Anon., *Fiji Times and Herald*, Suva, November 14, 1944.

A Factor in Clover Nodule Formation Associated with the Volume of the Medium Occupied by the Roots

In the course of experiments involving the growing of clover seedlings (Late-flowering Montgomeryshire Red) on agar medium in test-tubes, it was noticed that the number of nodules produced per plant depended upon the number of individual plants occupying the same tube. As the nodule bacteria were present in very large numbers, this variation in nodulation cannot be due to paucity of organisms; indeed the question raised is rather why so few nodules are formed on plants in spite of the massive infections of the root hairs which are known to occur[1].

Experiments to elucidate both these questions are being carried out and a short report of the first result obtained is presented here.

Clover plants were grown in tubes (6 in. × ⅝ in.) on slopes of a 1·2 per cent agar medium previously sterilized, containing mineral salts but deficient in nitrogen, and inoculated with nodule bacteria. The experiment was arranged in such a way that the number of plants sown per tube and the volume of agar medium was varied. The number of nodules produced per plant was counted after a period of 120 days, and the mean number of nodules and the volume of medium per tube are entered in Table 1.

TABLE 1. MEAN NUMBER OF NODULES PER PLANT.

Volume of medium per tube	1 plant per tube	2 plants per tube	3 plants per tube
4 c.c.	20·4 ± 2·0	9·3 ± 1·9	5·3 ± 1·1
8 c.c.	34·9 ± 3·7	16·1 ± 3·4	12·1 ± 3·1
12 c.c.	31·5 ± 4·6	23·5 ± 6·3	14·4 ± 2·3

It will be noted that for each volume of medium used the number of nodules per plant is inversely related to the number of plants in the tube. Further, the mean number of nodules per plant increases with the volume of medium per tube and is roughly proportional to the volume.

Assuming that these relations are such that: (1) the nodule number is proportional to the volume of the medium, and (2) is inversely proportional to the number of plants present, it is possible to calculate the expected number of nodules for each variant from the mean number of nodules per plant over the whole experiment. The calculated values are entered in Table 2, and with the single exception of the entry for one plant in 12 c.c. medium, the agreement between expected and observed values is very satisfactory.

TABLE 2. CALCULATED MEAN NUMBERS OF NODULES PER PLANT.

Volume of medium per tube	1 plant per tube	2 plants per tube	3 plants per tube
4 c.c.	16·4	8·2	5·5
8 c.c.	32·7	16·4	10·9
12 c.c.	49·1	24·5	16·4

The simplest hypothesis that this effect is due to direct competition for nutrients has been shown by later experiments to be inadequate to explain the results given above. That the effect is also not due to delay in nodulation is shown by the figures for mean leaf number at the time of primary infection in Table 3.

TABLE 3. MEAN LEAF NUMBER AT PRIMARY INFECTION.

Volume of medium per tube	1 plant per tube	2 plants per tube	3 plants per tube
4 c.c.	1·94 ± 0·10	2·31 ± 0·13	2·02 ± 0·07
8 c.c.	2·31 ± 0·22	2·25 ± 0·17	2·54 ± 0·20
12 c.c.	2·18 ± 0·20	1·72 ± 0·23	1·79 ± 0·09

With regard to the question of the comparativel few nodules formed on the root system in any treatment, the generally discarded hypothesis is revive that the nodule is a metamorphosed lateral roo and that the maximum number of nodules is determined solely by the potential number of lateral roo primordia present in the primary and secondar roots. In the course of this work selected lines o plants have been secured displaying large variation in nodule number under conditions already described In such cases the rate of increase in nodule numbe agrees strikingly with the rate of lateral root production in control uninoculated plants, but not wit the rate of increase in total length or extent of the root system. It has further been shown that diminution in nodule number following crowding of plants in a given volume follows closely the reduction of lateral roots under the same conditions.

In the absence of detectable competition effects as a clue to this specific volume relationship, it appears probable that the phenomenon can be attributed to some nodule- and lateral root-inhibiting excretion from the roots, the concentration of which varies with plant number and the volume of the root medium.

Experiments to test this hypothesis are now under way.

P. S. NUTMAN.

Microbiology Department,
Rothamsted Experimental Station,
Harpenden, Herts.
May 22.

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[1] McCoy, E., *Proc. Roy. Soc.*, B, 110 (1932).

Laue Photographs of Sub-crystalline Regions in 'Hybrid' Crystals of Potassium Dihydrogen Phosphate

ATTENTION has recently been directed[1] to the break-up of single crystals of Rochelle salt and of potassium dihydrogen phosphate (KH_2PO_4) into crystal 'hybrids' when these substances are cooled below their transition points. A similar phenomenon has now also been established by means of Bragg photographs in the case of potassium dihydrogen arsenate (KH_2AsO_4).

A number of novel features about the size and mutual relationships of the sub-crystalline regions within a 'hybrid' single crystal (cf. ref. 1 and Fig. 2) has been observed by means of Laue photographs. Fig. 1 shows portions of Laue photographs of potassium dihydrogen phosphate below and above the transition point. For these exposures, the crystal was mounted at the centre of a cylindrical camera, with the *c* axis vertical, and with the (100) face approximately at 37° to the beam of white X-rays. Below the transition point (Fig. 1, *a*), the Laue reflexions from the hybrid are split into two, three or four components according to their indices. Fig. 1 (*b*) was taken without changing the position of the crystal, some hours after its temperature had been

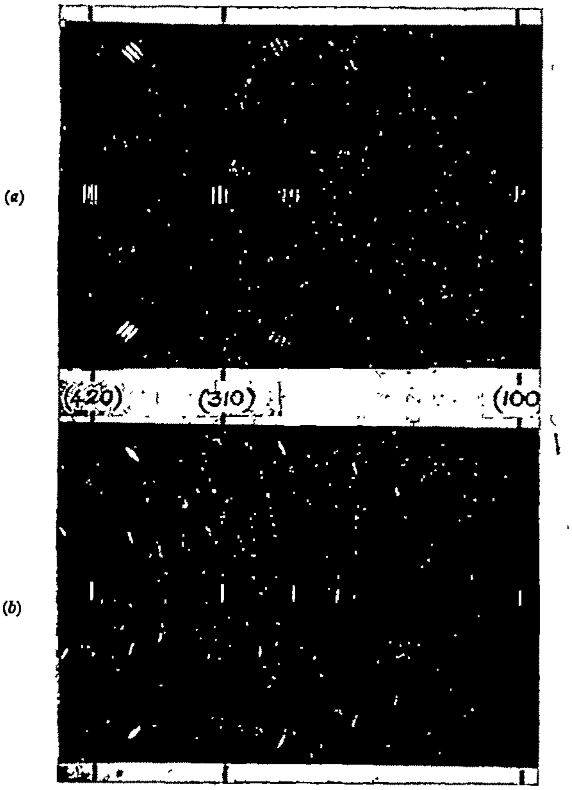

Fig. 1. LAUE PHOTOGRAPH OF KH_2PO_4. (a) AT APPROXIMATELY − 183° C. (b) REPEAT EXPOSURE WITH IDENTICAL ORIENTATION AFTER 18 HOURS AT ROOM TEMPERATURE.

raised above the transition point. The components of the split reflexions have merged to give the pattern of the original single crystal.

From these split Laue reflexions, interesting information can be obtained about the mutual relationships between the sub-crystalline regions within a 'hybrid' single crystal, about the size of the regions, and about the time required for the change from hybrid to single crystal and back again.

The fact that single Laue reflexions above the transition point are split into a finite number of components, rather than spread into a broad band, when the crystal changes to a hybrid, implies that the sub-crystalline regions of lower symmetry assume only a limited number of directions with respect to the original tetragonal axes. In general, a ($hk0$) reflexion is found to split into four components, when $h \neq k \neq 0$. The separation of these components varies with the ratio h/k, and the (100) and (010) show three components only, whereas the (110) shows only two. This can be accounted for by the fact that keeping the c axis the same, a sub-crystalline region of lower symmetry can be produced in four distinct orientations with respect to the original framework, and yet preserve one of its axes in common with the a or b tetragonal axes of the original single crystal (cf. Fig. 2).

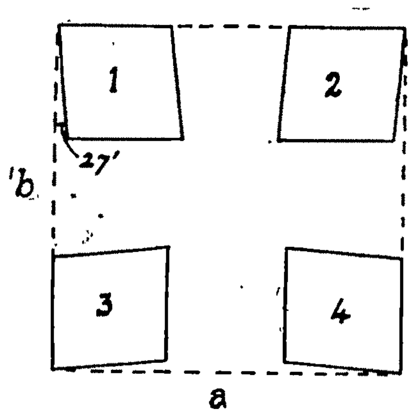

Fig. 2. POSSIBLE POSITIONS OF SUBCRYSTALLINE UNITS IN THE HYBRID WITH RESPECT TO ORIGINAL CRYSTAL AXES. (1) AND (2) a AXIS UNCHANGED. (3) AND (4) b AXIS UNCHANGED.

Information about the size of the sub-crystalline regions can be obtained from observations on the relative intensities of the components of a split reflexion. The intensities of each of a pair of components corresponding with orientations (1) and (2), or (3) and (4) of the units (cf. Fig. 2), are found to be the same, showing that the crystal as a whole remains electrically neutral. But in general, the intensity of one pair may be notably greater or smaller than that of the other. If the portion of the crystal illuminated by X-rays were of about the same size as, or smaller than, a single sub-crystalline unit, only one of the four components would be observed for any given setting of the crystal. On the other hand, if the portion of crystal illuminated were so large as to contain very many units, statistical smoothing would lead to equal intensities for all four components. In actual fact, with the sizes of crystals and X-ray beam used, the relative intensities of the components lie between these two extremes. From this, a provisional estimate of the size of the sub-units is about 5×10^{-3} cm. side.

Finally, Laue reflexions permit some estimate of the time of reversion from a hybrid to a true single crystal, when the temperature is raised above the transition point. With some crystal specimens, this change is completed within a few minutes at room temperatures. With others, hysteresis is more marked and split reflexions can be observed which coalesce after a few hours to give the pattern of a single crystal (Fig. 1).

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[1] *Nature*, 155, 170 (1945).

R286

Afterglow Effects in High-Pressure Gases

WE have recently demonstrated[1] the existence of afterglows following intense spark discharges in argon, hydrogen and other gases at pressures of 1–2 atmospheres. The submission of this further note, in advance of a more detailed publication[2], is prompted by Lord Rayleigh's recent experiment[3] and Jabłoński's comments[4]. The recent work of O'Doherty[5,6] is also relevant.

Experiments with square current-pulses indicate that afterglows persist after the cessation of current flow. Fig. 1 shows an oscillogram of the current wave for a discharge across a 0·5 cm. gap between tungsten electrodes in hydrogen at 18 lb./sq. in.

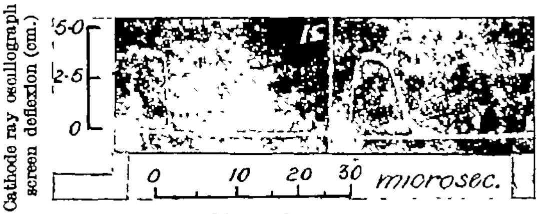

Fig. 1. Fig. 2.

pressure. The light output from the discharge, as recorded by a photo-electric electron multiplier, is shown in the oscillogram of Fig. 2. An afterglow of short duration, about 2 microsec., is observed, which was not observable in our earlier rotating mirror experiments[1] with damped condenser discharges.

The afterglow in hydrogen is explained by us[2] as due to the finite thermal capacity of the spark channel, leading to the delayed emission of light by electron/ion recombination, by the simple thermal excitation process, or by a combination of both effects. Radiationless three-body collisions are also probably of importance, since the ion densities in the spark channels are very high (10^{17} ions/c.c. or more).

Lord Rayleigh[3] showed that afterglows of about 10 microsec. were observable with electrodeless discharges in hydrogen at 0·2 mm. pressure and, despite the calculated rise in gas temperature of about 38,000° due to the extremely high instantaneous power dissipation in the discharges, no interpretation of the results was given. It was pointed out, however, that the time of persistence (about 10 microsec.) of the Balmer lines was about a thousand times as long as the life of the excited states in question.

In our experiments the spark channels were fairly sharply defined, so that estimates of surface area, rate of heat loss, etc., can be made[2]. It is found that the thermal time constant is of the order required to explain Fig. 2, and although it is difficult to make similar calculations for Lord Rayleigh's tube, it is considered likely that the afterglows observed with it can be explained in the same way. The persistence of the Balmer lines for times greater than the normal life-time of excited atoms is therefore to be expected. Jabłoński's suggestions are to be supported, with the important addition of thermal excitation as a means for providing delayed emission.

The experiments are being continued and extended in several directions[7] with increased accuracy, in particular to decide the relative importance of the various effects responsible for afterglows and to investigate spark channels and other transient gas discharges.

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[2] Craggs, J. D., and Meek, J. M., submitted for publication; work completed July 1944.

[3] Lord Rayleigh, *Proc. Roy. Soc.*, A, **183**, 26 (1944).

[4] Jabłoński, A., *Nature*, **155**, 397 (1945).

[5] O'Doherty, J. J., *Nature*, **153**, 558 (1944).

[6] O'Doherty, J. J., *Nature*, **154**, 339 (1944).

[7] Craggs, J. D., *Quart. J. Roy. Met. Soc.*, **70**, 167 (1944) (discussion on paper by T. E. Allibone).

Allotropic Modifications of Diamond

THE relationships which exist between the structural symmetry of a molecule and its spectroscopi behaviour have been fully worked out by Placzek[1] One result of his theory is that if a molecule has th symmetry of the crystallographic point-group *Oh*, th activity of its vibrations in infra-red absorption an in light-scattering are mutually exclusive. On th other hand, if the molecular symmetry is that of th point-group *Td*, every vibration of the triply degenerate class must appear both in light-scatterin and in infra-red absorption, or else be absent i both.

Placzek's theory is applicable, *mutatis mutandis*, t the spectroscopic behaviour of crystals in respect o their fundamental lattice vibrations. The consequences of it mentioned above afford a straightforward explanation of the remarkable fact that while all diamonds exhibit in light-scattering a intense line with a spectral frequency shift of about 1,332 wave numbers, the corresponding infra-red absorption appears only in some diamonds, but not in others. This difference in spectroscopic behaviour is, in fact, a complete demonstration of the existence of allotropic modifications of diamond and shows further that the forms more commonly met with showing the infra-red absorption have only tetrahedral symmetry of structure, while the less common variety, in which the absorption is absent, has the full symmetry of the cubic system.

The crystallographers of the nineteenth century (for example, Groth[2] and Miers[3]) who, on the basis of the observed crystal forms, assigned to diamond the lower or tetrahedral symmetry, recognized it as a necessary consequence that two variants of it, namely, the positive and negative tetrahedral forms, must exist, and explained the comparative rarity of forms clearly exhibiting the lower symmetry as the result of their interpenetration. Apart from the crystallographic evidence which supports this explanation, there is an array of experimental facts concerning diamond established by my work and that of my collaborators[4], which proves that such an interpenetration does really exist in diamonds having tetrahedral symmetry of structure. The evidence can be summarized in the statement that while the characteristic infra-red absorption goes hand in hand with various other physical properties, for example, blue luminescence, ultra-violet opacity, feeble but sharply defined classical X-ray reflexions and small photo-conductivity, all these properties themselves are highly variable, and that such variations are perfectly correlated with each other. The interpenetration of the positive and negative tetrahedral structures in different degrees and the resulting variations of structure afford a natural interpretation of these facts.

The existence of two sub-classes *Oh* I and *Oh* II in the octahedral division is also indicated by the highly characteristic laminated structure parallel to the octahedral planes which is characteristic of this type of diamond, and which readily reveals itself under the polarizing microscope. The observed structures cannot be explained on the basis merely of a random irregularity or mosaicity of the crystal lattice. Indeed, the high intensity of X-ray reflexions characteristic of this type of diamond is definitely associated with its laminated structure, as has been clearly demonstrated by the X-ray topographs of Mr. G. N. Ramachandran[5]. Finally, it should be marked that the appearance of geometric patterns cleavage plates of diamond exhibiting the local ariations in the various physical properties mentioned above is a convincing ocular demonstration f the fact that we are really dealing with distinct llotropic forms of diamond, as also with the consequences of their interpenetration and/or interwinning.

The above statement of the case is by way of reply o Mrs. Lonsdale's letter published in *Nature* of ebruary 3 last. She does not discuss the array of acts brought forward in the symposium but hallenges' what she refers to as a 'speculation' on he basis of certain minor aspects of the X-ray ehaviour of diamond, which are not really fundamental to the issues under consideration. Mrs. onsdale believes that the specific points mentioned y her controvert the main thesis established by the ork of my collaborators and myself; this is not so. As the present letter, however, is already of sufficient ength, a detailed examination of those points must e reserved for a separate communication.

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Groth, P., "Physikalische Kristallographie" (Leipzig, 1895), 575.
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Ramachandran, G. N., *Proc. Ind. Acad. Sci.*, A, 19, 280 (1944).

Infra-Red Spectrum of Diamond

The new theory of crystal dynamics put forward by Sir C. V. Raman[1] leads in the case of diamond to the result that the atomic vibration spectrum of this crystal should exhibit eight distinct monochromatic frequencies. Of these, the mode of highest frequency (1,332 cm.$^{-1}$) corresponds to the triply degenerate vibration of the two Bravais lattices of carbon atoms with respect to each other, and this is active or inactive in infra-red absorption according as the crystal structure of the diamond possesses tetrahedral or octahedral symmetry. The other seven frequencies represent oscillations of the layers of carbon atoms parallel to the faces of the octahedron or the cube occurring normal or tangential to these planes, with the phase reversed at each successive equivalent layer. By the nature of the case, such oscillations should be *inactive* in the infra-red absorption as fundamentals; but owing to anharmonicity, the octaves of these frequencies should be capable of appearing in infra-red absorption. Besides the octaves, various combinations of these frequencies would also be active in infra-red absorption.

A detailed exploration of the infra-red absorption band exhibited by diamond in the region of wavelengths between 4 μ and 5 μ was made by Robertson, Fox and Martin[2], using a concave grating of one metre focus of echelette type, in conjunction with a prismatic instrument. The investigation showed that the band had an observable fine structure; indeed a whole series of sharply defined peaks or absorption maxima was noticed, the positions of which were capable of exact measurement within a few wave-numbers.

These results must be considered surprising on the basis of the older theories of crystal dynamics, according to which the vibration spectrum of a crystal is essentially a continuous one. Indeed, it is not easy to see how any explanation of the experimental facts could be offered on the basis of those theories. On the other hand, they find a natural explanation on the basis of the new dynamics as explained above.

Both in the earlier investigation of Robertson, Fox and Martin[3] and the later one mentioned above, the two most conspicuous and sharply defined absorption peaks are those at wave-numbers 2170 and 2028. These agree within a wave-number or two with the octaves of 1088 and 1013 respectively which represent the frequencies (determined by other spectroscopic methods) of the atomic vibrations normal to the octahedral planes. The other peaks in Robertson, Fox and Martin's curve may also be explained quite accurately as allowed combinations of the lattice frequencies.

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[1] Raman, C. V., *Proc. Ind. Acad. Sci.*, A, 18, 237 (1943).
[2] Robertson, Fox and Martin, *Proc. Roy. Soc.*, A, 157, 579 (1936).
[3] Robertson, Fox and Martin, *Phil. Trans. Roy. Soc.*, 232, 463 (1934).

Shear Modes in Non-Piezo-Electric Crystal Plates

Recently we described a new method[1] for the determination of the elastic constants of crystals, utilizing ultrasonic waves of continuously varying frequency. At that time, it was thought that the method would not permit the thickness transverse vibrations to be detected. The full set of elastic constants could be obtained only after supplementing the work by a few static torsion observations.

Further work has now revealed that these transverse or shear modes can also be transmitted through crystal plates and communicated to liquids in the form of consequential longitudinal strains. Associating such transmission maxima with thickness transverse frequencies, torsion constants for crystal plates can be calculated and the full set of elastic constants obtained by purely dynamical methods. This result has now been used for checking previous measurements on some crystals and to make new measurements on others. Full details and the numerical results are being published elsewhere.

It may be pointed out here that this observation is analogous to that of Bhagavantam and Suryanarayana[2], who have recently demonstrated that besides the usual longitudinal ones, shear modes also can be excited in piezo-electric crystal plates and transmitted to liquid media as corresponding longitudinal waves.

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[1] Bhagavantam, S., and Bhimasenachar, J., *Proc. Ind. Acad. Sci.*, A, 20, 298 (1944).
[2] Bhagavantam, S., and Suryanarayana, D., *Nature*, 155, 171 (1945).

COMBINED RAW MATERIALS BOARD

THE third annual report of the Combined Raw Materials Board covers the year ended January 26, 1945, and shows clearly that the international planning of the production and distribution of industrial raw materials, the world demand for which exceeds the supplies available, will long be required. The progress of the War during 1944, and the completion in large measure of the major planning tasks in the raw materials field in support of the war effort, permitted the two member Governments to review the Board's duties and terms of reference and to consider what modifications might be necessary in future.

The Board was designed as a war-time organization; but it is encouraging to learn that it has been decided, as a result of these discussions, that the Board shall continue in being for the duration of the War against Japan, and to operate under its existing terms of reference and with the increasing collaboration of the other United Nations most closely concerned. The text of a joint public announcement of January 19, 1945, which covers also the Combined Production and Resources Board and the Combined Food Board, is appended, and should remove the fear of any hasty jettisoning of the war-time machinery of economic partnership and control, and of the liberated countries of western Europe seeking to outbid each other or their more prosperous neighbours for scarce materials by independent buying in the markets of the world.

The report indicates a general improvement in 1944 in the raw materials position, and stringencies were arising less from shortages of raw materials than from other factors, particularly the shortage of labour for processing raw materials. The Board has been able to relax close control over certain grades of asbestos, balata, balsa wood, cobalt, mercury, mica, molybdenum, shellac, tantalite and tungsten, but on the other hand, sudden and unforeseen changes in the demand and supply position made it necessary to restore close control of antimony and zinc. Combined action was also necessary to deal with new shortages of jute, platinum, lead, casein, animal glue-making materials and goatskins, and the report refers to the way in which changes in military requirements and the needs of newly liberated countries prevent the guarantee of equilibrium. The acute dearth of natural rubber and of hard hemp persisted, and the Board urges that the conversion from the use of natural to the use of synthetic rubber should be vigorously pursued in all consuming countries. The situation with regard to hides and leather steadily worsened during 1944, and is likely to be one of the most serious facing the Board during 1945. Arrangements have already been made to bring the United Nations Relief and Rehabilitation Administration and the governments of Europe financing their own reconstruction requirements into close working arrangements with the Board to ensure that the orderly flow of hides may continue as new claimants against the world's supply enter the picture.

Particularly during the latter half of 1944, the governments of the liberated areas were in constant consultation with the Board regarding their requirements of essential raw materials, and although no substantial deliveries were possible before the end of the year, these claimants may cause new stringencies in raw materials available for civilian use in t United States, Great Britain and elsewhere duri 1945. Within the narrower range of scarce commo ities such as hides and leather, lumber, paper a pulp, cordage fibres, jute and lead, the legitima needs of Europe will curtail the quantity available f others, although on the other hand the industri output of western Europe should soon help counteract the current deficits in such items as tyr and textiles.

MICROFILM AND OTHER MEAN OF DOCUMENTARY REPRODUCTION

AT the nineteenth annual conference of t Association of Special Libraries and Informati Bureaux held in December last, it was felt that justi could not be done to the photographic reproducti of documents by microfilm and other methods witho a special conference on this subject alone. Such conference was therefore held in London in the roo of the Royal Society during June 1–2, under t auspices of the ASLIB Microfilm Service. Its thr sessions drew a full gathering of some hundred an fifty librarians and other workers in bibliographic fields, including many from government department and a number of representatives of the photograph industry. The first two sessions were devoted large to technical matters related to copying and reprodu tion processes, and the third and last session to th vexed question of copyright. At all three sessions th vigour of the discussions, quite as much as the hig quality of the contributions of the principal speaker provided a measure of the value of the conference and if little was achieved in the way of proposals fo that standardization which would do more tha anything else to promote the use of this valuable ne tool—a tool destined, some maintain, to transform research library practice—the conference did succee in demonstrating the variety of purposes for whic document-copying by photographic means is needed, and in suggesting some of the directions in which advances are likely to be most rapid.

After a brief speech of welcome had been made by Prof. A. V. Hill, who presided over the opening session, Mr. F. J. Tritton (of Ilford Limited) gave a clear and admirable survey of the principal photographic methods of document-copying and of the technical problems they involve, illustrating his remarks by reference to full-size paper reproductions, by the various processes, of a page of an ordinary journal comprising letterpress and illustrations in line, stipple and half-tone. For satisfactory reproduction of typographic matter, some overall gain in contrast is generally considered desirable, and while this does not affect the clarity of line and stipple illustrations, it gives poor reproduction of half-tone blocks. A compromise is therefore necessary, and since the greater bulk of material normally copied is purely typographic, materials of relatively high contrast are generally preferred; their development can, when necessary, be so modified as to reproduce half-tones satisfactorily. The processes can be classified as (*a*) those needing a camera, yielding records either substantially full-size (for example, photostat, using paper) or of reduced size (microfilm), and (*b*) those requiring no camera, but employing straight contact-printing to give a full-size copy, among these ng reflex processes, applicable to documents nted on both sides. Any of these processes can be de to yield a negative (the sole copy) or an limited number of positives (from a master negave). The choice of process depends much on the lume of work to be done, since gross costs are viously affected by the cost of the apparatus needed making the copy and in using it; it depends also the purpose of the work, since evidently if reduced ulk is important, whether for storage or transport, me such method as microfilm is essential.

Other processes were mentioned in the course of an nimated discussion, among them in particular being he 'micro-print' processes which have recently tracted considerable attention, especially in America. case in point was the 'micro-card' system which as been described at length by Fremont Rider, brarian of the Wesleyan University Library, in The Scholar and the Future of the Research ibrary" (see *Nature*, **154**, 655; 1944). Rider, impressed by the average rate of growth of American search libraries, which, he finds, double in size every xteen years, has proposed that the back of the pical 5 in. × 3 in. library index card should carry reduced image of up to one hundred pages of the xt of the document catalogued; and thus, in short, at the research library of the future would be oused *on the back* of its catalogue cards, the cards hemselves being produced at a cheap rate and in elatively large editions by central reproducing gencies. Mr. Tritton believes that a special difficulty f this and other micro-print systems using high egrees of reduction, quite apart from the present ack of satisfactory reading apparatus, is the obliterating effect of dust-particles settling during the copying of the original or in the course of printing. ther micro-print processes were mentioned in discussion, including one by Dr. Carl White of Columbia niversity, by which reduced copies of 25 pages of n original are offset-printed upon a single printed age of normal size.

Notwithstanding these developments, micro-film remains at present, in Great Britain and the United States, the medium most widely used for bulk reproduction work. A very pertinent discussion, therefore, was prompted by the second paper of the conference when Mrs. L. Moholy (director of the ASLIB Microfilm Service) reported on discussions she has had with Dr. L. A. Sayce on the important practical questions: whether perforated or unperforated film should be used, and whether a fixed frame-length should be adopted or a frame-length varying, at a fixed degree of reduction, with the length of the original document. Unperforated film offers greater economy in film area and therefore in weight, and has been employed by the ASLIB Microfilm Service, much of the output of which has been sent overseas. On most technical grounds it has much to commend it, but difficulties have arisen because unperforated film cannot be passed through the sprocket-driven apparatus which has for the most part been used in Britain.

An interesting discussion led to a suggestion that in future ASLIB should supply perforated film unless unperforated be specifically requested, since the former can be used in any reading apparatus. Similar divisions of opinion were clearly shown on the question of fixed frame *vs.* varying frame. The majority of speakers favoured the former, which simplifies apparatus problems (automatic selection of frames in reading and analysing machines) and makes for ease of filing and indexing of short lengths of film, though it can be somewhat wasteful of film when the page size of the originals varies.

A similar diversity of present-day practice was seen in the field of reading apparatus, described by Mrs. L. Moholy in an illustrated lecture on "Projectors and Reading Machines" at the second session of the conference. The discussion showed, so far as a synthesis of the diverse needs of different classes of user is at all possible, that the ideal microfilm reader would probably be a relatively light and portable apparatus giving an easily readable image projected on a white reflecting surface (rather than on a diffusely transmitting screen), the apparatus being adapted to take a film bearing images either along or across its width and having conveniently operable means of changing from one frame to another and of selecting a desired frame as quickly as possible, and at the same time taking up so little space on a desk as to leave plenty of room for notebooks, etc. If we add that the apparatus would have to be produced cheaply because, it was urged, the average research user would want a reader on his desk and not merely in the central library of his department, we realize that no such reader exists as yet. Reference was made in discussion to a small cheap folding reader made of cardboard, adapted to take a few frames of film, which was used during the War for supplying information to the F.F.I. in France, the folded card reader and the microfilm being dropped from the air.

It was stated by some speakers that most users of microfilm services prefer to have prints which can be read direct, and while this may be due in part to the lack of really satisfactory readers, there is no doubt that a print which can be filed for easy reference has many advantages for the research worker. The storage of microfilm and its resistance to wear were also mentioned. Work carried out in the United States and elsewhere has shown, Mr. Tritton said, that provided the photographic processing has been properly carried out, the age of a microfilm record should be at least as great as that of the original document. Exposure to tropical atmospheric conditions should be avoided by air-conditioning film-storage compartments, but such steps are not necessary in temperate climates. As to wear in the course of handling, that appears to depend on the care taken by the user; but Mrs. Moholy emphasized that master copies should not be used in readers.

During this second session of the conference, at which Dr. C. H. Desch took the chair, Mr. G. R. Edwards (secretary of the Royal Society of Medicine) gave an account of the microfilm service which has been provided since the outbreak of war by that Society, as a means of providing its overseas members with information on request. It had been widely used, also, by the Director General of the Army Medical Services. Mr. Edwards pointed out that microfilms not only occupy a much smaller space than photostat copies, but also cost considerably less. It is certain that in future any library of standing will have a film reader and should be ready to use every type of technical device to disseminate its material. The use of such devices should, therefore, be taught in courses on librarianship.

The final session of the conference was in the form of a 'brains trust' on documentary reproduction and copyright, with Mr. G. S. W. Marlow, barrister-at-law (secretary of the Faraday Society), as chairman and question-master. The 'brains trust' consisted of

Prof. J. D. Bernal, Mr. E. J. Carter, Dr. Arundell Esdaile, Dr. C. H. Desch and Mr. R. A. Lochner. The chairman opened the proceedings with a summary of the relevant parts of the law of copyright. The making of a photographic copy is obviously "reproduction of the original" within the meaning of the Acts, but since the Acts permit "fair dealing" with an original for the purposes of private study and research, the problem raised by photographic reproduction is largely "When is dealing fair ?" In the course of the answers to this question, in which the audience shared freely, Prof. Bernal thought that scientific workers have long been breaking the law not only for study but also for criticism. To him, "fair dealing" implied the question: Was the photocopying service one for which money could reasonably be asked by the owner of the copyright ? If the copies were made for the use of one or two persons only, it would be very different from copies made for class-teaching on a large scale. Dr. Esdaile amplified this by saying that fair dealing ceased when the commercial interests of the owner were injured. Mr. A. G. Dance, of the Ministry of Education, said that the matter is one of great consequence, and some decision must soon be reached because the Ministry was hoping to see a very considerable increase in the use of film strip after the War. Several speakers urged the advertising value of photocopies. If production of photocopies, so far from reducing the demand for the original, stimulated such a demand (as has happened with the B.B.C. in the concert field), then injury to the owner of the copyright could scarcely be said to have occurred. Mr. Tritton went further, stating that the authors of much of the material now being microfilmed are individual scientific men and other professional workers whose greatest reward lies in the wide dissemination of their works, for which they rarely receive payment in money. Mr. Chilton added that the copying of individual articles in journals puts these articles at the disposal of research workers who only in rare instances could be expected to subscribe to the original journals, especially when account is taken of the widespread scatter of material on any one subject throughout the thousands of current scientific and professional periodicals. It was generally agreed, however, that since publishing bodies are inevitably business concerns, copyright problems cannot be got round in this way.

Dr. R. S. Hutton and Mrs. Moholy pointed the way to a solution of the problem, first referring to present U.S. practice whereby the purchaser of a photocopy declares that he will not use the copy other than for the purpose of private study, and secondly calling for a less cumbersome arrangement with the owners of copyright than the present one, which requires that in cases of doubt the copying agency has to make contact with the owner before proceeding with the copying. Time-saving being one of the greatest advantages of photocopying methods, it is desirable to have an automatic arrangement with copyright owners concerning the terms under which they are prepared to permit photocopying. It would then be possible for a copying agency like ASLIB to carry out its work without specific reference to publisher or author in any particular case.

It has been impossible in the course of a brief review to cover the many interesting points arising from this conference, but it is understood that the proceedings will be available in due course.

L. V. CHILTON.

BRITISH MUSEUMS DURING TH WAR YEARS

"THE great task of museums and art galleries this country during the War is to help preser the basic sanity of our peoples and anything that c be done in this respect will be of greater ultima value than most of us perhaps can now realize These words are quoted from a message from Maj S. F. Markham to members of the Museums Associ tion in 1940. How the museums and art galleri have endeavoured to carry out this task is the subje of the leading article entitled "Endeavour ar Achievement", appearing in the *Museums Journal* April 1945. The information contained therein based upon the many museum and art gallery repor received regularly at the offices of the Museun Association in London.

The author states that the large majority of thes institutions have not only continued their activiti throughout the war period, but also that they ha considerably risen in public appreciation; that the development, far from being curtailed by war cond tions, has been greatly accelerated; and that "th support of museum and art gallery activities is no accepted as a normal service in any progressive cit or town". Some of the causes leading to this sati factory position are to be looked for in the popula short-term exhibitions of material supplied b government departments, the Council for the En couragement of Music and the Arts, and many othe organizations; the co-operation of the museums an art galleries with government departments and th various Services in the provision of instruction fo men and women in the Forces, and of loan-exhibit to camps, canteens and clubs; the arrangement made for discussion groups, concerts and art exhib tions; the many informative exhibits and talk dealing with the need for fuel economy, paper salvage food production and so on; and the special caterin for the needs of leisure and thought by carefu presentation of artistic, historical and scientifi material.

That the need for such amenities is very real i proved by the overwhelming response of the public wherever they are provided, and the results fully demonstrate that where the service is well rendered there will it be well received—indeed, even demanded. Nevertheless, the high attainments of even a majority of institutions must not be allowed to mask the fact that there are still far too many areas in Great Britain where the museum service is static, in decay, or even non-existent. Further, reports from even the larger museums continue to stress the need for expansion, better staffing, better working facilities, and more adequate expenditure; and there has been much criticism from not unimportant quarters. Even the writer of the article outlined above is aware of such matters, for he writes, ". . . it is of paramount importance that museums and art galleries should turn their present proud position to good account when peace returns. Directors and curators should take their rightful place in the circle of leading professional men and women who render notable service to the community". And again, "The Museums Association is staking a general claim for the advancement of museums and art galleries throughout the country, but local authorities must adapt this according to their individual needs". At this point, however, one may doubt whether *all* local authorities e sufficiently interested in, or informed of, this rticular public service, and hence whether they are ualified to come to any conclusion at all about such eeds'. One more statement from the article under nsideration is worth quoting for the light it throws pon a not uncommon official attitude towards useums: "Museums have been the Cinderellas of e services for too long a time". It is evident, erefore, that many of these institutions are at resent in a state of suppression, and that the cause ay be ill-informed, ungenerous, or timid rule. It is vident, also, that various authorities, whether they re responsible for the conduct of a museum service r not, have yet to be convinced of the value of the useum in the fields of education and research, and n the intelligent and constructive use of leisure.

HISTORICAL LIBRARY OF YALE UNIVERSITY SCHOOL OF MEDICINE

THE difficulties of scientific libraries, the meagre funds sometimes allocated to them and the devoted labours of those who work obscurely in them or the benefit of science are often not adequately ppreciated by those who would be the first to maintain that libraries are essential tools of research. It would, indeed, do most undergraduates and esearch workers in science departments no harm to work for a month or two in a library; for only those who have sufficient imagination can realize, without his practical experience, all the labour and organization which goes to the making of an efficient library ervice. One record of this kind of service is given in the reports for the years 1941–44 of the Historical Library of Yale University School of Medicine (Sterling Hall of Medicine, New Haven, Connecticut).

During the first year (1941–42) this Library, which was endowed by Harvey Cushing and dedicated on June 15, 1941, made vigorous efforts to build up its collections, especially those relating to the medical history of the War of 1914–18; the Library is also associated with the work of the National Research Council's Subcommittee on Historical Records of the medical history of the present War. The same Council financed the publication of a classified bibliography of aviation medicine prepared by the Yale Historical Medical Library, supplements to which have been requested by the National Research Council's Sub-committee. The problems which occupied this busy year are discussed in these reports. One of the Library's most useful decisions was that books should be available on loan without restriction, and many scholars outside Yale have benefited from this. Another valuable service is the opening of the Library for seven days a week.

The Library's outstanding treasures are the collection bequeathed to it by Harvey Cushing himself and the other one bequeathed by Dr. Arnold Klebs, who died in 1943 in Switzerland, where his books await transportation to Yale. These collections will place Yale in the forefront of libraries concentrating on fifteenth-century literature. To them the Library can add, among its other treasures, the collection of Prof. J. F. Fulton relating largely to the seventeenth century. Prof. Fulton's other devoted services to the management and general policy of the Library as chairman of its Advisory Board are evident throughout these reports. He is also consultant to the Army Medical Library, the system of classification of which the Yale Library now follows. Another feature of the Library's work has been the lectures and demonstrations given each year by Dr. Arturo Castiglioni. The Library has issued the catalogue of Harvey Cushing's collection, which has been considered the finest gift of books by a medical man since William Hunter left his library to the University of Glasgow. Cushing's collection is rich in documents on the anatomy of the Renaissance, the surgery of Tudor England and Vesalius' books. The great historical Library now being formed at Yale is a fine memorial to Cushing, and under the care of Prof. John Fulton and his colleagues it will fare well. G. LAPAGE.

MARINE ECOLOGY IN SOUTH AFRICA*

PROF. T. A. STEPHENSON and his assistants have studied intensively the intertidal fauna and flora of South Africa for many years, and the result is a valuable series of ecological memoirs. In Part 1 (1939) of this paper, an account was given of zonation in the intertidal belt surrounding South Africa, to which were added details of the distribution of the Patellidæ. The present part describes the distribution on the South African coasts of the more important intertidal species, and defines the geographical components of the fauna and flora. A third part is to be published later which will include, among other items, a comparison of results with those of other workers.

A very large amount of work is entailed in this survey, and the results are of great interest. Altogether a coast-line of about 1,820 miles has been surveyed and about 1,200 species identified. The most important forms on which attention has been concentrated number 318 (202 animals and 116 algæ).

The intertidal fauna and flora comprise four components—a very large warm-water component supreme in the east but dying down westward; a smaller, but important, cold-water component, paramount westward but diminishing eastwards; a component centred about the south coast, disappearing to the eastward and westward, and a component consisting of species which occur around the entire coast from Durban to Port Nolloth. In addition there appear to be components of more local range centred about different parts of the coast.

Two very large elements are included; one endemic or indigenous to South Africa, the other consisting of species with an East African, Indic or Indo-Pacific range. Apart from these, other elements (Atlantic, sub-antarctic, cosmopolitan, etc.) are represented in relatively small proportions. The number of species rises steadily from west to east.

A comparison of the zonation of these coasts brings out roughly a *Littorina* zone, recognizable throughout although the species of *Littorina* change from east to west; a Balanoid zone throughout, everywhere inhabited by *Patella granularis* as well as by barnacles, but westward the barnacles diminish leaving the Patella dominant; a zone of *Patella cochlear* throughout the greater part of the coast; but at both the eastern and western ends complications appear due to the diminution of that species and the consequent dominance of other forms; and the lowest zone, the sub-littoral fringe, is also demonstrable throughout though its population changes and it becomes rather vague to westward, where it represents the fringe of the (mainly sub-littoral) Laminarian zone.

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* The Constitution of the Intertidal Fauna and Flora of South Africa. Part 2. By T. A. Stephenson. With Plates XII–XIV and 13 text-figures. *Ann. Natal Mus.*, 10, Part 3 (Dec. 28, 1944).

The replacement of certain forms is interesting. Thus the polychæte *Gunnarea capensis* drives out *Patella cochlear* in places, and mussels replace limpets in others. Also algæ replace other algæ or limpets. The illustrations of the zoning, in many cases coloured, are very attractive and informing.

Such a survey as this can only be done by steady team-work, and the difficulties overcome are very large. Prof. Stephenson is to be congratulated on the large amount of valuable work accomplished, and it is hoped that it may continue on the same lines.

FORTHCOMING EVENTS

Saturday, July 7

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES (at the Rothamsted Experimental Station, Harpenden), at 9.30 a.m.—Fiftieth Annual Congress. Prof. W. G. Ogg: "Some Aspects of the Work at Rothamsted".

INSTITUTE OF PHYSICS (LONDON AND HOME COUNTIES' BRANCH) (in the Physics Department, Imperial College of Science and Technology, South Kensington, London, S.W.7), at 2 p.m.—Discussion on "The Corrosion of Metals".

Tuesday, July 10

QUEKETT MICROSCOPICAL CLUB (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 7 p.m.—Conversation and the Exhibition of Specimens.

Wednesday, July 11

GEOLOGICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Prof. W. W. Watts, F.R.S.: First William Smith Lecture.

Wednesday, July 11—Thursday, July 12

IRON AND STEEL INSTITUTE (at the Institution of Civil Engineers, Great George Street, London, S.W.1)—Annual General Meeting.

Wednesday, July 11

At 10.30 a.m. and 2.30 p.m.

Thursday, July 12

At 9.45 a.m.

Thursday, July 12

ROYAL SOCIETY (at Burlington House, Piccadilly, London, W.1).—Dr. W. T. Astbury, F.R.S.: "The Structure of Biological Fibres and the Problem of Muscle" (Croonian Lecture).

Thursday, July 12—Friday, July 13

SOCIETY OF CHEMICAL INDUSTRY—Sixty-fourth Annual Meeting.

Thursday, July 12

(At the Chemical Society, Burlington House, Piccadilly, London, W.1), at 10.30 a.m.

Friday, July 13

(At the Royal Institution, Albemarle Street, Piccadilly, London, W.1), at 10.30 a.m.—Business; at 11.30 a.m.—Presidential Address; at 3 p.m.—Presentation of the Society's Medal to the Rt. Hon. Viscount Leverhulme, and Medallist's Address.

Friday, July 13

ROYAL ASTRONOMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Discussion on "The Origin of the Solar System" (Speakers: Prof. W. H. McCrea, Dr. A. Hunter, Dr. R. A. Lyttleton and/or Mr. F. Hoyle).

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

WOMAN ABSTRACTOR (Ref. F.4217.XA) with experience in scientific and technical abstracting, a GRADUATE PHYSICAL CHEMIST (Ref. F.4218.XA) with research experience in Rheology or Surface Chemistry; and a PHYSICAL CHEMIST (Ref. F.4219.XA) with Honours Degree and aptitude for research, by a Research Association—The Ministry of Labour and National Service, Central (T. and S.) Register, Room 5/17, Sardinia Street, Kingsway, London, W.C.2, quoting the appropriate Reference No. (July 12).

QUALIFIED DEVELOPMENT ENGINEER to take charge of Desig Testing and Development of range of Hydraulic Pumps (locatio Gloucestershire)—The Ministry of Labour and National Servic Appointments Department A.9, Room 5/17, Sardinia Street, King way, London, W.C.2, quoting C.2403.XA (July 13).

LECTURER IN THE DEPARTMENT OF PHYSICS—The Secretary, Th University, Edmund Street, Birmingham 3 (July 14).

ASSISTANT LECTURER IN ELECTRICAL ENGINEERING in the Bradfo Technical College—The Director of Education, Town Hall, Bradfo (July 14)

DEPUTY BOROUGH ELECTRICAL ENGINEER—The Town Clerk, Tow Hall, Great Yarmouth (July 16)

AGRICULTURAL CHEMIST, and a BIOLOGIST—Acting Director Agriculture, School of Agriculture, Houghall, Durham (July 18).

CIVIL ENGINEERS for service on a railway extension in Iraq—(Assistant Civil Engineer (Ref. E.1740.XA) capable of taking charg of setting out for railway construction, measuring up work, takin out quantities, and preparing certificates for payment; (*b*) Juni Civil Engineers (Ref. E.1705.XA) with good experience of instrume work for setting out earthworks for railway work, cross sectionin measurements, etc.—The Ministry of Labour and National Servic Appointments Department A.9, Room 5/17, Sardinia Street, King way, London, W.C.2, quoting the appropriate Reference No. (July 20

LECTURER IN INDUSTRIAL ADMINISTRATION and an ASSISTA LECTURER IN INDUSTRIAL ADMINISTRATION—The Registrar, Colleg of Technology, Manchester 1 (July 20).

LECTURER IN CHEMISTRY in the Constantine Technical College—The Director of Education, Education Offices, Middlesbrough (July 21

RESEARCH OFFICER FOR X-RAY CRYSTALLOGRAPHY, Division Industrial Chemistry, Council for Scientific and Industrial Researc Melbourne—The Secretary, Australian Scientific Research Liaiso Office, Australia House, Strand, London, W.C.2 (July 23).

ASSISTANT LECTURER IN THE DEPARTMENT OF ENGINEERING—Th Registrar, University College, Singleton Park, Swansea (July 30).

PROFESSOR OF GEOGRAPHY, and a LECTURER IN GEOGRAPHY, in th University of Ceylon—The Vice-Chancellor (Dr. W. Ivor Jennings, 23 Grange Road, Cambridge (July 31).

LECTURER IN FORENSIC MEDICINE AND TOXICOLOGY—The Secretar School of Medicine Committee, Westminster Hospital Medical School 17 Horseferry Road, London, S.W.1 (July 31).

SECRETARY—The Director, School of Oriental and African Studies University of London, London, W.C.1 (August 15).

PROFESSOR OF CHEMISTRY—The Secretary, Royal Technical College Glasgow (August 31).

LUCAS CHAIR IN THE PRINCIPLES OF ENGINEERING PRODUCTIO (applicants should have high qualifications in Engineering an experience in industry)—The Secretary, The University, Birmingham (September 1).

LECTURER IN SOCIAL ANTHROPOLOGY—The Secretary, The University, Edinburgh (September 30).

ASSISTANT LECTURER, or LECTURER, IN THE DEPARTMENT OF GEOGRAPHY (with good qualifications in Geomorphology)—The Registrar University College, Southampton.

HEADMASTER, Grade III (Honours Graduate, with interest in Technical Education) of the Technical High School—The Director of Education, Education Offices, Library Street, Blackburn.

GRADUATE TEACHER OF GENERAL SCIENCE, especially Chemistry, in the Technical Institute and Junior Technical School—The Secretary and Director of Education, Education Offices, Guild Street, Burton-upon-Trent (endorsed 'T').

PRINCIPAL of the Cardiff Technical College—The Director of Education, City Hall, Cardiff.

TEACHER (full-time) OF MECHANICAL ENGINEERING SUBJECTS, in the Technical Institute and Junior Technical School—The Clerk to the Education Committee, Education Offices, Trafalgar Road, Great Yarmouth.

TEACHER (part-time, evening) IN PHYSIOLOGY—The Director of Education, The Polytechnic, 309 Regent Street, London, W.1.

ASSISTANT MASTER TO TEACH ENGINEERING SCIENCE, PRACTICAL GEOMETRY AND MACHINE DRAWING in the Heaton Technical School—The Director of Education, City Education Office, Northumberland Road, Newcastle-upon-Tyne 2.

ASSISTANT MASTER TO TEACH SCIENCE AND MATHEMATICS in the Oldham Municipal Technical College—The Director of Education, Education Offices, Oldham.

ASSISTANT LECTURER IN AGRICULTURAL ECONOMICS—The Registrar, University College of Wales, Aberystwyth.

LECTURER IN CHEMISTRY, with qualifications in Organic Chemistry—The Registrar, University College, Exeter.

TEACHER OF ENGINEERING DRAWING, ENGINEERING SCIENCE, Practical Mathematics, Workshop Technology, Jig and Tool Drawing, and Design, to Ordinary National Certificate standard in the Redditch Technical School—Mr. G. Brodrick, Education Office, Church Green West, Redditch, Worcestershire.

REPORTS and other PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Imperial Bureau of Animal Breeding and Genetics. Technical Communication: The Semen of Animals and its Use for Artificial Insemination. By Dr. James Anderson. Pp. viii+151+9 plates. (Aberystwyth: Imperial Agricultural Bureaux, 1945.) 7*s.* 6*d.* [26

Empire Cotton Growing Corporation. Annual Report of the Administrative Council for the Season 1943–1944, submitted to the Twenty-fourth Annual General Meeting on June 5th, 1945. Pp. 18. (London: Empire Cotton Growing Corporation, 1945.) [96

Catalogue

A Catalogue of Books and Periodicals on Arithmetic, Astronomy, Chemistry, Electricity, Engineering, Mining, Navigation, Physics, etc. (No. 630.) Pp. 32. (London: Bernard Quaritch, Ltd., 1945.) 6*d.*

NATURE

No. 3950 SATURDAY, JULY 14, 1945 Vol. 156

CONTENTS

	Page
ence and National Defence	29
ish Physicians Through History. By Dr. Walter agel	31
se and Sensation in Philosophy. By Prof. A. D. itchie	33
ino-Acid Constituents of Proteins	33
ermal History of the Earth. By Dr. E. C. Bullard, R.S.	35
e New Organic Chemistry. By Dr. D. H. Hey	36
Experimental Treatment of the Apical Meristem in erns. By Prof. C. W. Wardlaw	39
ituaries :	
Dr. Stanley W. Kemp, F.R.S. By Dr. N. A. MacIntosh	41
Prof. Eugène-Louis Bouvier. By Dr. E. Hindle, F.R.S.	42
ws and Views	43
tters to the Editors :	
Animal Learning and Evolution.—Dr. W. H. Thorpe	46
Inheritance of Melanism in Grey Squirrels.—Monica Shorten	46
Heterokaryosis and the Mating-Type Factors in *Neurospora*.—Eva Sansome	47
Bionomics of *Hylemyia cinerella* Fallen.—Dr. M. Hafez	48
Inhibitory Action of Dialkyl Succinic Acid Derivatives on the Growth *in vitro* of Acid-fast Bacteria.—Vincent C. Barry and Dr. P. A. McNally	48
'Fissibactericidal' Nature of Penicillin Action.—Dr. S. W. Lee, E. J. Foley and E. R. Caley	49
An Undialysable Pressor Principle in Organ Extracts.—Prof. U. S. v. Euler and E. Östlund	49
Losses of Nitrous Nitrogen from Soils on Desiccation.—Dr. M. R. Madhok and Fazal-Uddin	49
'Electron Radiography' using Secondary β-Radiation from Lead Intensifying Screens.—H. S. Tasker and H. W. Towers	50
Accuracy of Atomic Co-ordinates Derived from Fourier Synthesis.—A. D. Booth	51
A Colour Reaction in Yeast.—Mignon Malm	52
Halogenation in the Allyl Position.—Dr. William E. Vaughan, Frederick F. Rust and George W. Hearne ; Dr. W. A. Waters	53
Operators in Quantum Theory.—J. L. B. Cooper	54
Reform of the Patent Law in Britain.—Prof. Michael Polanyi, F.R.S. ; The Writer of the Article	54
Strength of Glass and Duration of Stressing.—F. W. Preston	55
Avoidance of Obstacles by Bats.—Prof. H. Hartridge, F.R.S.	55
Archæological Exploration in South Africa.—Prof. D. M. S. Watson, F.R.S.	55
Science and Education. By Sir Robert Watson-Watt, C.B., F.R.S.	56
Estimation of Multiple Correlation by Means of Stereographic Projection. By G. F. K. Naylor	58
Indigenous Forests of New Zealand. By Prof. E. P. Stebbing	60
British Army Veterinary Services in the Far East. By Dr. G. Lapage	60
Arts and Crafts of the Cook Islands. By Mrs. K. Rishbeth	61

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SCIENCE AND NATIONAL DEFENCE

NOTHING emerges more clearly from the debate in the House of Lords on May 29 on the control of German war inventions and that on May 30 on the future of directed missiles than the imperative need for a national policy for defence. Without such a policy clearly formulated and rightly aligned with those of the other members of the United Nations organization, there can be no security or world order, or effective prosecution of reconstruction plans. Unless satisfactory answers are forthcoming to some of these difficult questions and an honest effort made to achieve adequate solutions, all our plans for building a world free from fear and want and squalor may fall to the ground. The world organization adumbrated by the United Nations Charter, the control of Germany, and national defence and international security are all interlocked. The allocation of resources, both of materials and of man-power, between the different purposes must be carefully balanced, or mankind may be plunged once more into an armament race and a world war from which there may be no recovery.

There can be no doubt as to the immense importance of the part which science has to play in this question of national defence and of the control of Germany, and scientific workers have no more urgent duty than that of addressing themselves to this problem. It is not a task to be undertaken, however, in isolation from the rest of the community. There must be the fullest and widest possible public understanding of what science and the scientific worker can—and can not—do in this matter. Hence it is of the utmost importance that the report of the committee of scientific men which, Lord Cherwell stated, the Government has appointed to advise on planning our methods for controlling German industry and to consider the whole question of the future of German scientific research, should receive the widest possible publicity.

The two debates were of service in emphasizing the futility of attempting to organize a system of collective security without some reference to developments in new technique and the means of watching and controlling them ; they equally emphasized the need for further attention to the formulation of policy. At present, as Lord Cherwell stated, the requirements of the three Services in regard to new weapons are co-ordinated by a fully representative inter-Services committee, and intensive work on longer-term projects is being co-ordinated by a special organization in which all those interested besides the users, technicians and scientific workers from both within and outside the Ministries are represented. What will happen, if and when the Ministry of Supply vanishes, Lord Cherwell could not predict, and it was clear from his speech that no decision has been taken upon the organization of the Services, the continuation of the Ministry of Defence and so on.

These are all questions that should stand above party politics, and on which it should be possible to formulate a policy and an organization which would command the support of every party. That point of view and the urgent need for clear thinking on these issues has been further illustrated, since the debate, in the seventh and final report of the Select Committee on National Expenditure for the session 1944–45. One of the main lessons of modern war, it is observed, has been the essential need for maintaining the closest contacts between all three Fighting Services and a fully co-ordinated control over their operations in the field. The necessary corollary to this is the establishment of similar contacts and controls in their supply services and in the basic research upon which these in their turn must rely. Attempts to solve the major problems of administration and government organization involved must lead to reconsideration of the present allocation of departmental responsibilities, and the Select Committee reports its conviction that these problems must be squarely faced and attacked with the least possible delay. It is one of the first questions to which the new Parliament should give its close attention.

The Select Committee's report does not so much indicate the lines on which a solution is to be found as adduce evidence of the dangers of neglect and of the soundness of its conclusion as to the urgency of the whole question. Methods of control and accounting suitable for ordinary administrative expenditure are not necessarily, it points out, those that lead to the most fruitful achievements in research. For that purpose, block grants should be sanctioned for specified periods of years ; and parliamentary control of this type of public expenditure may require the development of a new technique.

In addition, there are the further problems of securing the maintenance, both in industry and under government control, of active and fully skilled organizations, with the necessary tools and equipment, for the development of new results flowing from basic research, and for carrying out specific applied research and linking up these establishments, so that the fullest unity of purpose can be maintained between research, manufacture and operational requirements. It is of first importance that the permanent cadre of the armed forces should always have available during peace-time an adequate quantity of the most up-to-date weapons and stores that continuing research and development can provide, not merely for the purpose of training and for use in any war in which the country may become involved, but also because by field experience the fighting man can himself play an important part in the most effective development of war material. This experience should be shared with the Dominions, and the present system for co-ordinating research and design between Great Britain and the Dominions should be continued in peace-time and the Dominions invited to co-operate intimately at all stages.

Without going into details of examples of wasted expenditure, the Select Committee points out that, taken together, such examples show that, at least during the earlier years, the daily cost of the War was unnecessarily increased and the duration prolonged because research had for long been starved, no adequate steps taken to maintain in peace a nucl of skilled men which could be rapidly and efficien expanded for the purposes of war, and because t system of departmental responsibility was insu ciently flexible fully to meet the changed requi ments. Critical examination indicates weaknes inherent in the system and roughness in its machine rather than failures in the execution of allotted tas These weaknesses should, however, have been fo seen ; and now that they are fully recogniz immediate and vigorous action should be taken put them right.

Maintaining the view which it has consistent upheld, that national economy can be firmly bas only on the best outlay of the nation's resources, t Committee has no fears that, if research and develo ment are maintained at a high level and encourag by the right methods of control and co-ordinatio and if the terms of employment offered attract t best brains to the service of the State, the nation bill for the equipment and maintenance of its forc in a state of fighting efficiency will be dispropo tionately large. In the long run, uneconom restriction in research expenditure and failure evolve means of securing the closest contacts betwee the scientific worker, the manufacturer and t fighting man must inevitably lead to gross extrav gance and perhaps imperil the existence of the natio It must never be forgotten that owing to a par monious attitude to research and consequent unpr paredness, the first two or three years of the W were spent by scientific men and research workers i a strenuous attempt to make up for lost tim Recurrence of these difficulties can only be prevente by securing the technical initiative during the year of peace and welding this to the war potential.

But technical initiative—which the Committe defines as the ability to develop and maintain technique of maximum weapon-power and to evolv a policy of strategy accordingly—is only one factor i defence policy. Account must also be taken of man-power reserves and economic resources, and the extent to which they can be mobilized in an emergency. Even technical initiative involves having at the service of the State trained scientific men, inventors and manufacturers whose continuing preoccupation with the problems of warfare will render them the more capable of speedily producing antidotes to new and unsuspected enemy devices.

An adequate defence policy, however, involves more than the considerations covered in the Select Committee's report and the establishment of appropriate relations both between departments and between civil and military research. It means also the quantitative and qualitative study of the man-power position of the nation, and a decision on the question as to whether conscription or other form of national service is to be a permanent feature of the national organization. It means decisions as to the size of the armed forces as a whole, and the relative deployment of man-power between them. Moreover, as the War has taught us, it involves making service in the armed forces an attractive career to able and public-spirited youth.

Again, on the production side, besides those alitative aspects implicit in the observations of the lect Committee, there are quantitative considerans equally important. The quantitative requirents for minimum defence needs will be dictated rtly by the decision as to the size of the armed rces to be maintained, which itself will depend in n on the defence organization established in -operation with others of the United Nations. ch requirements will also be related to the needs reseen during the expansion period required to ise production to its war-time level. Nor can a fence policy in its production aspect pretend to be equate or complete which does not take full count of the shadow-factory principle or that of spersion. Further, certain industries such as synetic rubber, high octane fuel, light metals and alloy eels may require special measures to ensure that e production is always in keeping with war-time otential needs and that they are not so located as be unduly vulnerable to attack. When such prolems as shipbuilding, aircraft production, food stocks d production, with all the repercussions which their lation to a defence policy must have upon indusial location and reconstruction and the allocation f man-power are also considered, the imperative ecessity for clear thinking on defence and for keeping he issues so far as possible free from all party controersies should be obvious. Only so can the cost of a efence policy which provides the material security, without which social security is impossible, be kept within limits which will not hinder the execution of hose measures of social reform and reconstruction on which hopes are so widely fixed.

(To be continued)

JEWISH PHYSICIANS THROUGH HISTORY

The Jews and Medicine

Essays. By Prof. Harry Friedenwald. (Publications of the Institute of the History of Medicine, the Johns Hopkins University, First Series: Monographs, Vols. 2 and 3). Vol. 1. Pp. xxiv+390+9 plates. Vol. 2. Pp. ix+391–817+3 plates. (Baltimore, Md.: Johns Hopkins Press; London: Oxford University Press, 1944.) 2 vols., 50*s*. net.

THE history of the Jewish physician, his role in the development of medicine, science and general culture and his influence on the fate and history of Jewry have not infrequently been the subject of articles, addresses and small monographs. Most of these tend to degenerate into crowded catalogues of eminent medical men who happened to be Jewish by faith or race. The Jewish physician has always been the child of his own age, and though very often highly original and ingenious, was not a creator or exponent of 'Jewish medicine', and this may explain the shortcomings of some of the historical representations which we possess without invalidating the need for comprehensive biographical studies of Jewish medical and scientific men set against the Jewish and general cultural background of their period. Yet, there certainly is a 'Jewish medicine'—the medicine of the Bible and the Talmud, specifically Jewish in its blending of ritual and hygiene, legal casuistry and medical knowledge. Medicine here emerges as a by-product of the primarily juridical and ritual concerns of the Talmud, and is to a large measure derived from the medical sources and schools of the Greco-Roman culture enveloping Jewish life in Talmudic times in Palestine and elsewhere. Nevertheless it is full of original features which stand out in its best representation, the "Biblical-Talmudic Medicine", by Julius Preuss (1911), to which one example may be added, the original prescription of sweets for 'Bulmus', that is, ravenous hunger due to a hypoglycæmic condition.

The present work is a collection of essays published, since 1917, by H. Friedenwald, emeritus professor of ophthalmology in the University of Maryland. Without attempting a comprehensive history of the whole subject, its treatment in the form of essays enables the author to exhaust his particular problem, and thereby to avoid the mistakes of his predecessors. The love for his subject, documented by fifty years of skilful gathering and studying of a unique collection of pertinent manuscripts, incunabula and books, animates his thorough and scholarly representation, which brings out new points, facts and vistas. Thus his "Bibliography of Ancient Hebrew Medicine" (Essay VIII) adds to that of Preuss many new items from the seventeenth century down to 1942, and is better arranged than any previous classification. Perhaps such a bibliography might be extended to cover even a wider range, including the medical aspects of 'Jewish archæology' (in the sense of Samuel Krauss), Jewish folklore, medical occultism, etc.

In a religious community, medicine has to establish itself. "The best of physicians is fit for hell" is an old Jewish epigram, because physicians are over-confident in their craft and tend to commercialize their profession. According to the Great Rabbi Loew of Prague, 'hell' stands for the material world which the Kabbalah holds to be negation of real existence, that is, the spiritual; the physician as well as the naturalist who knows only the material world will end in hell, that is, in non-existence. But Jewish physicians such as Maimonides were keen naturalists, averse to magic and superstitious practices such as the use of charms, amulets, etc., and the Talmud found subtle and progressive justification for professional medicine as practised by many of its authorities, the Rabbis, which may be read in the author's essay (No. II) on "Judaism and the Medical Art". "The Ethics of the Practice of Medicine from the Jewish Point of View" (Essays III and IV) found remarkable expression in "Apologetic works of Jewish Physicians" (1588, 1631, 1679).

The paramount role of the Jews in the preservation and transmission of Greek and Arabic medicine to the Occident is further illustrated by manuscripts acquired by the author and described in detail, to which a bibliography of medical works in Hebrew is appended (Essays VIII–XI). In the pre-Arabic period (seventh to tenth century A.D.), Hebrew had been used as a literary medium by such writers as Asaph and Donnolo. With the growing need for Arabic and Latin literature felt by Jewish students and physicians, these works were translated into Hebrew. During the Renaissance, humanistic interests account for the use and description of Hebrew anatomical terms by Vesalius and plant-names by Thurneysser, and for a Hebrew translation of the Hippocratic Aphorisms (Gaiotius 1647; it may be pertinent to add that as late as 1847 such a translation was published in Britain in Young's "Israelitish Gleaner", p. 33). The historian will welcome the lists of Jewish writers in Arabic and of the principal Jewish medical translators and their translations into Hebrew which are appended.

The picture would not be complete without extensive reference to the ordeals and difficulties to which the Jewish medical and scientific men were exposed, and much of this can be found in the biographical essays, especially those dealing with the Marrano physicians, which form the main part of the work under review. What the Jewish medical student had to face in these times is vividly described in "The Jews and the Old Universities". At certain Jewish "Schools" (for example, in Paris and perhaps in Mantua) medicine was taught in Hebrew. These schools rivalled in the fourteenth century the University of Paris, and the medieval universities, which were ecclesiastical throughout Europe, took formal action against Jewish students, though not until after the fifteenth century, and even then degrees were conferred on Jews on special authorization from the Pope. Jews served as distinguished lecturers in Italian universities from the fifteenth century onwards, and at Padua no less than 230 Jews qualified between 1517 and 1721—though not without a remarkable run of artificial difficulties. No such tolerance was practised in Protestant countries (with the exception of Holland). The prominent part played by Jews in the history of Montpellier, which probably owes its foundation to Jewish scholars from Spain, is the subject of a separate essay in which sketches can be found of Prophatius, the Saportas, Nostradamus, Sanchez (the famous sceptic philosopher), and Jean Astruc. The latter (1684–1766), celebrated as the inaugurator of the Elohist-Yahwist theory of Bible criticism and critical defender of the theory of the American origin of syphilis, came from a Spanish-Jewish family, as Friedenwald proves with finality (the fact as such was known before; see, for example, A. Sack, "The Problem of Genealogy of Syphilis". Aerztliche Mitteil. aus. Baden, 1932, p. 304).

It is these Spanish-Jewish families of Marranos from which sprung many of the most brilliant scholars and medical men and which, therefore, form the main subject of Friedenwald's biographic and bibliographic studies. Marranos were Jews in Spain and Portugal who were forcibly converted to Christianity, and in many instances continued in secret to practise Jewish ceremonies and transmit the Jewish religion to their descendants. To all familiar with their history it is well known that apparent or real devotion to the Church and high favour enjoyed at the hand of Emperor or Pope is no proof against the Jewish origin of a scholar. This particularly applies to Andres a Laguna (1499–1563), so far only known as one of the greatest physicians of his time and quoted as such by Cervantes, who, as Friedenwald shows, gave in 1555 the *experimental* proof that the root of nightshade causes certain "vain phantasmagorias" such as are associated with witchcraft, a discovery which enabled Laguna to oppose the age-old views of witchcraft, before Wierus, who is commonly regarded as the first in this field. The setting of this discovery is of particular interest. It occurs in an annotation to Laguna's Spanish translation of the materia medica by Dioscorides in the section entitled "Solano". When municipal physician at Metz in 1545, Laguna, as he tells us, recovered in t hermitage of two wizards (one of whom had be burnt as a witch), a pot with an ointment "that seem to be composed of the very coldest and sopori herbs; which are the cicuta, the nightshade, t henbane and the mandragore". He used it on t wife of the executioner who suffered from intractab sleeplessness. She fell into a deep sleep from whi she was aroused with difficulty after thirty-six hou and related her pleasant sensations during slee including cohabitation and "many other stran things", which were ascribed to the "cold" quali of the ointment causing a "frigidity in the diabolic parts from which there comes a humour as cold ice". Laguna concludes that witches, though deser ing of punishment for making a pact with the dev in reality never leave—neither in spirit nor in body the spot where they fall asleep. The devil imparts h knowledge of the virtue of such *pharmaka* to th witches, etc. It is noteworthy that the mediev rabbis (Maimonides, Gersonides and others) neve believed in the reality of witchcraft, and Amatu Lusitanus as well as Montaigne (the son of a Marran mother) may have been influenced in their enlightene views towards witchcraft by Laguna.

Space does not permit detailed reference to th many other essays, which include complete historica surveys of the Jewish physicians in Italy, and of Spain Portugal and south-eastern France, with a complet list (and 67 pages of short biographies) of the Spanis and Portuguese physicians after the expulsion at th end of the fifteenth century, and many individua biographies (notably of Amatus Lusitanus, and hi work in the discovery of the venous valves, Mon talto, and the eminent physiologist Moritz Schif (1832–96).

Here, then, is the first comprehensive source book for the history of the Jewish physician, a work indispensable for the student of history in general, Jewish history, the history of medicine and science, and last but not least, for the philosophical observer of human tolerance and of obscurantism. This latter aspect may be illustrated by passages from the essay on Jewish physicians in Spain and Portugal (pp. 614, 618, 647): "During the Moorish supremacy the Jews were among the leaders in the schools of Cordova and Toledo. They enjoyed a period of development in which their studies in science, medicine and philosophy . . . and their poetic productions thrived in so marvelous a manner that it is still described as the Golden Period." . . . "In 1148 . . . the fanatical Almohades conquered the land and the Jews were forced to accept the Muslim faith, their wives and children were sold as slaves and their synagogues and schools were destroyed." In Christian Spain towards the end of the eleventh century, Alfonso VI said: "Jews furnish our vezirs, chancellors and most of our officers . . . and we cannot do without them". But in 1391 a tide of discrimination led to frightful massacres. In Seville the mob killed four thousand Jews, in Cordova two thousand corpses lay in heaps in the streets and in the wrecked synagogues. From Cordova the spirit of murder spread throughout Spain to Aragon, Catalonia, Barcelona and Gerona. These persecutions were the immediate forerunner of the Inquisition.

The work is beautifully illustrated and produced, under the auspices of the Institute of the History of Medicine of the Johns Hopkins University and its director, Henry E. Sigerist, who contributes a preface.

WALTER PAGEL.

CAUSE AND SENSATION IN PHILOSOPHY

roceedings of the Aristotelian Society

New Series, Vol. 44: Containing the Papers read before the Society during the Sixty-fifth Session, 1943–944. Pp. xxx+160. (London: Harrison and Sons, Ltd., 1944.) 25s. net.

THE nine papers in volume 44 of the *Proceedings of the Aristotelian Society* cover a wide range of ubjects, including logic, psychology, ethics, religion. Three are likely to be of special interest to scientific readers. Though the authors approach the subject n different ways and quite independently, they all attack the phenomenalist or positivist view of scientific knowledge. Mr. J. C. Gregory, writing on 'Causal Efficacy", argues that those who treat causation as nothing but regularity of succession ignore the universal background of all thinking, primitive or dvanced. The notion of activity or efficacy belongs to this background. Dr. J. O. Wisdom in an article on "The Descriptive Interpretation of Science" admits that, so far as it provides a maxim of caution against postulation of unnecessary entities, the descriptive interpretation is useful, but urges that t cannot possibly be taken as final. Experiments are made and experimental science exists only because of the expectation that things will behave in definite ways; an expectation which the descriptive view dismisses as groundless.

Prof. H. H. Price, in his presidential address "Touch and Organic Sensation", clinches the argument with admirable force and lucidity. He points out that phenomenalists and positivists, all those who take the descriptive view of science, the regularity view of causation, and treat matter as a logical construction, are visual philosophers. "Hume *looked* at his billiard balls. And all that he could see was that one moved whenever the other struck it. Indeed, in any causal transaction there is nothing else to be *seen* except the concomitance of two events. But the tactual conception of causation is quite different." Organic sensation, if we take it to be the genus of which tactual and muscular sensation are species, reveals a world different from that of visual experience. The difference is specially marked if visual experience is taken, as it so often is, to exclude peripheral vision or anything ill-defined. The first main difference is that organic sensation is better analysed in terms of feeling and content (I feel tired) than of act and datum (I see a cat). The second is that it provides unity or wholeness as well as voluminousness and interpenetration, qualities singularly lacking in sight. As to its different modes, tactual experience gives rise to the obstacular conception of matter and muscular experience to the activity conception of causation. These conceptions do not arise in the first place from inferences made by comparing sets of experiences, but are given as qualities of tactual and muscular sensation. Lastly, muscular activity combined with other forms of organic sense provide a basis for self-consciousness; what it feels like to be alive.

The reason why organic sensation has been neglected and purely visual philosophy so much favoured is that for purposes of theory it is convenient to take sight as the model or type sense. Its range, flexibility and precision make it a specially suitable medium for theoretical statements. Moreover, long before science existed human language had developed a visual bias in its terminology. The result is that any other sort of perceptual experience tends to be interpreted in visual terms, and often, as Prof. Price argues, misinterpreted.

A. D. RITCHIE.

AMINO-ACID CONSTITUENTS OF PROTEINS

The Amino Acid Composition of Proteins and Foods

Analytical Methods and Results. By Dr. Richard J. Block and Diana Bolling. Pp. xiv+396. (Springfield, Ill., and Baltimore, Md.: Charles C. Thomas; London: Baillière, Tindall and Cox, 1945.) 6.50 dollars.

AT a time when the world faces a food shortage for man and beast, the nutritive evaluation of protein foodstuffs is a matter of first importance. The relative values of the different proteins in nutrition are based upon their content of those special amino-acids which cannot be synthesized in the animal body and are indispensable for its growth and continued health. All these 'essential' amino-acids are not present in every protein. With a knowledge of the amino-acid composition of the various animal and vegetable proteins, it is possible to choose proteins so that they become mutually supplementary, and thus to ensure a diet that contains the qualitative and quantitative requirements of essential amino-acids.

Obviously the selection of proteins to form an adequate diet depends on accurate estimations of the amino-acid constituents. The analytical methods used in such estimations are scattered widely throughout the literature. It is difficult without much experience to assess the value of several differing methods employed in the estimation of the various amino-acids. Dr. Block and Miss Bolling have collected together analytical methods for the estimation of the essential amino-acids and also of those non-essential amino-acids which can be evaluated with some degree of accuracy. In this way it is possible to compare the content of a specific amino-acid in the same protein as determined by many different procedures.

Attention has been directed to the one great difficulty in any accurate determination of amino-acids in proteins, which is the loss, to a greater or less extent, of the amino-acids by the process of hydrolysis. The methods which have been employed to arrive at an estimate of losses during hydrolysis are discussed in some detail for each of the main groups of amino-acids.

The authors have wisely given the various analytical methods in detail, including not only those employed for determinations but also for separation of specific amino-acids from protein hydrolysates. At the end of each section on a group of amino-acids, they have listed with references the values obtained by different workers for several proteins. Their opinion as to 'best values' may not receive general approval, but it is valuable to have such an opinion based as it is on wide experience.

This book is not only a most timely but also a most welcome addition to the literature of the proteins. It is well indexed and documented with a valuable bibliography. British readers will envy the way in which the book has been produced, with its clear printing on good paper.

Some British Moths

By Norman Riley. (King Penguin Book.) Pp. ii+30+16 coloured plates. (Harmondsworth and New York: Penguin Books, Ltd., 1944.) 2s.

ALL moths are not clothes moths, nor do all caterpillars eat cabbages, as many laymen still believe. There is much ignorance to dispel, and at the same time a growing appetite for knowledge of wild life to satisfy. This attractively written and produced book should gain both these ends, opening up new fields of pleasure for the man whose garden and now lighted windows attract so many moths, or who takes his leisure in the countryside.

Writing simply but vividly, the author gives an account of the moth's life-history—the various tricks that protect it from its enemies, the marvels of its eyes and organs of touch and smell, how it finds its mate, etc.—that makes fascinating reading. Caterpillars, not merely objects of interest, are shown as living animals with their own problems of concealment and protection, feeding and final transformation.

The forty-six moths illustrated, most of which can easily be found or reared, are necessarily a small selection, but they represent most of the 'macro' families, and the family likenesses are usefully pointed out. Notes on when and where the moths occur and how they live are given. The coloured plates are from drawings by the eighteenth century naturalist Moses Harris, some of which are published for the first time. Their freshness and richness of colour and the life-like attitudes, with larva, pupa and food plant also depicted, make them attractive illustrations. One or two of the smaller figures are perhaps rather blurred for identification purposes.

The Distribution of the Birds of California

By Joseph Grinnell and Alden H. Miller. (Pacific Coast Avifauna, No. 27.) Pp. 608. (Berkeley, Calif.: Cooper Ornithological Club, 1944.) n.p.

THIS work was commenced by the late Joseph Grinnell in 1934, and before he died in 1939 he had completed about half the species. In 1940 Mr. Alden Miller undertook to finish the volume and, in addition, to revise the typescript already prepared.

Under each species there is a list of synonyms which apply to Californian birds. The information is arranged under three headings: status, geographical range and habitat. The first, in addition to stating whether the bird is common or local, has some remarks on migration. The paragraph dealing with the range of the species gives all the records of distribution over the whole area and any which refer to nesting or occurrences on migration. In every case the authority or reference is added to each record. The final paragraph describes the type of country occupied by the birds during the breeding and non-breeding season. At the end of the book there is a supplementary list of introduced birds and species of uncertain occurrences.

Hence this is solely a detailed record of the distribution of Californian birds, which must have taken an immense amount of labour to compile.

There is no summary or deductions to finish off the work, but at the end of the introduction Mr. Miller states that it is hoped to publish later information dealing with various aspects of Californian bird-life, such as the differentiation centres for races, intrusions of faunas from adjoining continental areas, and other problems. This will be a very valuable contribution, and we shall look forward to Mr. Miller's additional volume. There is on coloured plate and a number of useful maps showin the distribution of various races.

Garden Birds

By Phyllis Barclay-Smith. (King Penguin Book. Pp. ii+30+20 coloured plates. (Harmondswort and New York: Penguin Books, Ltd., 1945.) 2s

MANY persons who are not skilled ornithologist take a considerable interest in birds, particularly those that visit their gardens, and they feel th need for a concise, well-written, well-illustrated, inexpensive book to help them recognize their garde inhabitants and visitors. This want has been supplied by Miss Barclay-Smith. She writes of the differen types of gardens and the birds likely to be seen in them, of what can be done in the way of planting special trees and bushes to encourage birds, of the plants they like, about deterrent measures against cats, the provision of nesting boxes and how to make them, also the provision of nesting material, and lastly the necessity to supply food and water. Feeders are discussed and the food to be supplied, reference being made to the widespread idea that coco-nut may prove fatal to tits. She says, "it is open to doubt. It is, however, a good thing to spread the nut with lard occasionally to prevent it becoming too hard." The reviewer in pre-war days when coco-nuts were easily obtained always had two or three hung up for the benefit of the tits and never knew a bird any the worse. Miss Barclay-Smith goes on to give individual descriptions of some score of regular garden birds in Britain, her accounts being illustrated by twenty colour reproductions of plates from Gould's "Birds of Great Britain", which are ever vivid and fresh. F. P.

Faiths of Many Lands

By E. Royston Pike. Pp. viii+103. (London: Watts and Co., Ltd., 1945.) 8s. 6d. net.

THE world contains many great and interesting religions. To most of us in Great Britain the greater number are merely names. In this unusual little book they become realities, and we read not only of the religions and their founders, but also of the millions who practise these religions, and what effect they have on the lives of the believers. The style is vivid and direct, and certainly arouses interest in the subject.

It is meant for children, but I think it is more suitable for adolescents, or for those who know very little about the subject, and want a simple, interesting introduction to it. It will give many an inclination to go further and read yet more about the Buddhists, the Mohammedans, the Hindus, the Parsees and so forth. ENID BLYTON.

Recent Advances in Endocrinology

By Prof. A. T. Cameron. Fifth edition. Pp. vii+415. (London: J. and A. Churchill, Ltd., 1945.) 18s.

THE fifth edition of this book is well up to date. More clinical detail is given here than in previous editions, and this makes the whole more coherent and readable. Among the mass of added material may be found descriptions of the use of 'tagged' atoms in the investigation of thyroid metabolism and of the use of thiouracyl and thiourea in hyperthyroidism. There are some new illustrations and a comprehensive bibliography.

THERMAL HISTORY OF THE EARTH*

By DR. E. C. BULLARD, F.R.S.
University of Cambridge

Observed Temperatures

THE surface temperature of the earth is determined by the balance between the heat received om the sun and that lost to the atmosphere and by diation into outer space. It is close to the mean r temperature and usually slightly above it.

It has long been known that the temperature nderground is higher than this surface value and creases with depth. The rate of increase varies eatly even when volcanic districts are excluded. or example, in the lower part of the Reef-Nigel bore the Transvaal the gradient is 7·8° C./km., whereas a bore at Eakring near Nottingham it is 54° C./km. ven in a single bore it may vary greatly at different epths; for example, in the top 550 ft. of a bore at Holford, in Cheshire, Benfield[1] found a gradient of 1° C./km., while from 550 ft. to 1,300 ft. the gradient was only 10° C./km. A large part of these variations s due to the varying conductivity of the rocks; for example, the top part of the Holford hole is in marls of mean conductivity 0·0037 cal./cm. °C., whereas the ower part is in marl and rock salt of conductivity 0·0094. The heat flow calculated from the product of the gradient and the conductivity is nearly the same at ll depths in the hole. The variations in heat flow rom place to place are also usually smaller than the variations of temperature gradient.

There is a large body of temperature data, much of which has been taken with great care. Unfortunately, in the absence of information as to the conductivity of the rocks in which the gradients are measured, little use can be made of this abundant material. In the seventies and eighties of the last century a committee of the British Association measured the conductivities of a number of typical rocks. In 1935 a further committee was appointed to investigate the conductivities of specimens from borings where the temperature gradient is known. Thanks to the work of these committees, there are now a number of places in Great Britain[1,2], South Africa[3] and Persia where the heat flow is known. There is also a determination by Hotchkiss and Ingersoll from a mine in Michigan. The mean results are:

	cal./cm.^{2} sec.
Great Britain	1·0 × 10^{-6}
South Africa . ..	1·2 ,,
Michigan	1·0 ,,
Persia (provisional value)	1·3 ,,

The British values probably require to be increased by about 40 per cent to allow for the effects of the ice age. When the ice melted about ten thousand years ago, the surface temperature must have been raised by about 10° C., and the gradient near the surface will have been initially reversed. This irregularity will have gradually spread downwards and subsided, but after ten thousand years the gradient near the surface will still be less than its equilibrium value. It is probable that a detailed study of the variation of heat flow with depth in a suitable British bore hole about 3,000 ft. deep would give fairly definite information on climate in the last ten or twenty thousand years. The conditions for satisfactory results are stringent and are not at present satisfied by any bore.

There is surprisingly little difference in the mean heat flows in Britain, South Africa and Persia. In particular, the very low South African temperature gradients do not result from a low heat flow, but are entirely due to the conductivity of the Witwatersrand quartzites being high compared to that of the shales, limestones and marls in which most British temperatures have been measured. The difference in the observed gradients is thus due to economic rather than to geological causes; in England, holes are bored in search of coal, oil or water; in the Transvaal, in search of gold. A South African bore that passes through shales, such as that at Dubbeldevlei, has a temperature gradient similar to those found in England.

The main need at present in this branch of the subject is for more conductivity data, so that the conductivities of the rocks in the numerous bore holes in which reliable temperature measurements have been made can be estimated. Recent American work[4] has made it possible to do this for igneous rocks, and a few hundred more determinations on sedimentary rocks would probably make it possible to estimate the heat flow within 10–20 per cent at a large number of points. Results from the Alps and from other major mountain systems would be of particular interest.

Aside from possible regional variations there are local variations, sometimes reaching a factor of two, between the heat flows measured in individual holes in a single district. Part of these are due to geological structure, that is, to distortion of the lines of flow of heat by departures of the strata from horizontal planes. A salt dome provides an extreme example of this; the high conductivity of the salt relative to the surrounding rocks will cause heat to flow towards it from all sides and will thus increase the heat flow over the dome and decrease it at neighbouring points. Variations due to this cause and to topographic irregularities can be computed or determined from models, and it is desirable that a few cases be investigated in detail in order to determine how far such effects will account for the observed irregularities. Recent denudation and intrusion of salt masses may also cause variation of heat flow. Strong[5] has suggested that these causes have been important in Persia. Anderson[2] has pointed out that high values of the heat flow are observed near the system of tertiary dykes stretching from Mull to Durham. The extent of such disturbances, the magnitude of which it is difficult to estimate, will perhaps be clearer when the direct effects of structure and topography have been more closely investigated.

Source of Heat

Only about 20 per cent of the observed heat flow can be accounted for by the cooling of the earth from an originally molten state. Kelvin, reversing this argument, showed that an earth in which heat was not generated could not have been solid for more than about twenty million years, and still have a heat flow near the surface as large as at present. The remainder of the heat is presumably derived from the radioactive decay of radium, thorium and potassium. During the last thirty years, much work has been done on the amounts of the radioactive elements present in rocks. The accuracy of the early work has been questioned by Evans[6] and others in America. They have shown that some workers have used incorrect radium standards and that there are other incompletely elucidated sources of error. Unfortunately, the new American work deals only with American rocks, and in considering the world-wide distribution of radioactivity we have no alternative but to use the old results. In 1936 a comparison of all the existing data was made by Jeffreys[7]; this showed a fair degree of consistency and it is possible that many of the data are more accurate than is sometimes supposed. As a general rule, sediments and basic rocks are of low radioactivity compared with acidic rocks. There is a wide variation in the radioactivity of specimens from a single locality, and a variation in the mean from place to place. The distribution is markedly skew and care is necessary in the statistical treatment of the data. A detailed investigation of a number of specimens of granite from an area where the petrology is well known would be of great interest. As granite is much richer in radium than the surrounding sediments, the distribution of radioactivity through the rock might throw some new light on the controversy as to how far granite is formed by crystallization from the molten state and how far by migmatization of sediments.

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* A discussion with this title was held at the Royal Astronomical Society on March 23, 1945. It was opened by the present writer. The principal speakers were Mr. M. W. Strong, Dr. E. M. Anderson, Dr. H. Jeffreys and Mr. G. M. Lees. This article surveys the main points of the discussion and gives some additional comment.

A cubic centimetre of average granite produces about 0·5 to 1·0 × 10^{-12} cal./sec. The mean heat flow from the earth is about $1{\cdot}2 \times 10^{-6}$ cal./cm.^{2} sec., of which about 20 per cent may be of non-radioactive origin. The remainder could be produced by 10–20 km. of granite. This result means that the deeper parts of the earth must be almost entirely free from radium, thorium and potassium. If they contained these elements in anything like the same proportions as the surface rocks, the heat would be carried upwards by convection currents and would be conducted to the surface through the solid crust. If the rocks, by some miracle, solidified and stopped the convection currents, the heat would accumulate until melting again took place and the currents restarted. The present value of the heat flow can thus only occur if radioactivity to the extent shown by surface granite is confined to a crust 20–30 km. in thickness. Joly has suggested that there may be alternating periods of melting and solidification, but it is difficult to justify such a hypothesis.

There is some evidence that there is little or no granite under the main ocean basins. If this is so, the radioactive heat generated there may be expected to be less than that generated under the continents. It would be of great interest to verify this by heat flow measurements made under the oceans. There are serious but not necessarily insuperable difficulties in such measurements. The lower radioactivity will cause the temperature at a given depth under the oceans to be less and the density greater than under the continents. Such density differences, occurring at depths where the rocks are hot and probably possess little rigidity against long continued stresses, may cause convection currents moving upwards under the continents and downwards under the oceans. The density variations associated with such convection currents may provide the explanation of widespread fields of gravity anomalies which would otherwise force us to assume that the earth possessed considerable strength to great depths. The surface stresses produced by them may also play an important part in crustal deformation.

The deepest bore so far drilled is about 15,000 ft. deep. Beneath that, temperatures cannot be direc measured. Reasonable estimates may be made the outer 30–40 km. by assuming a structure bas on seismological results. The main uncertainty is the vertical distribution of radioactivity. The resu indicate that the temperatures are insufficient melt the rocks anywhere in the crust[8]. This sugge that extensive melting of the crust is only likely occur in geosynclinal areas where the crust thickened, or in some other abnormal circumstanc

As the surface heat flow is largely derived fro the radioactivity of the crust, it can tell us litt about the temperature below the crust. Theoretic estimates are subject to great uncertainty, b calculations have been made on the distribution temperature to be expected in a globe of molten ro which solidifies and thereafter cools by conduction[9]. Conduction only affects the upper five or six hundr kilometres; at this depth a temperature of abo 3,000° C. is reached. Below this, the gradient is equ to the rate of increase of melting point with dept due to the increasing pressure; this is probab about 3° C./km. Such a gradient would give a ten perature of about 10,000° C. at the outer edge of th core. The gradient in the thoroughly molten metall core is unlikely to be more than a few tenths of degree per kilometre, and the temperature attaine at the centre will not be greatly in excess of 10,000° C a temperature much less than that in the interior a star and almost within the range of laborator experience.

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THE NEW ORGANIC CHEMISTRY*

By Dr. D. H. HEY

DEVELOPMENTS in the theory and practice of organic chemistry during the past ten years have opened up a new and broader outlook on organic reactions in general. The reactions of classical organic chemistry, which in the main are concerned with reactions between two molecules or with reactions between an ion and a molecule, have been embraced within a comprehensive electronic theory, the main features of which were firmly established about fifteen years ago. To-day many examples are known of reactions which do not possess the characteristic features of the electronic processes generally referred to as 'electrophilic' or 'nucleophilic', and it is now necessary to consider a third type of reaction, namely, those between a molecule and either an atom or a free radical. Provision for this third type of reaction is obviously necessary, since it is possible to sever a covalent bond in one of two ways, resulting in heterolysis or homolysis, thus:

$$A:B \rightarrow A: + B \text{ (heterolysis)}$$
$$A:B \rightarrow A. + .B \text{ (homolysis)}$$

* Abbreviated from a lecture delivered before the Alembic Club, University of Oxford, on March 5.

The reactions of the free radical triphenylmethyl e well known, and physical chemists have for some nsiderable time recognized the existence of simple ee organic radicals of short life in many gaseous actions; but the triarylmethyls are highly specialed radicals with which few chemists make contact, nd the main and most familiar reactions of organic hemistry, such as are suitable for general laboratory nd industrial processes, are not gaseous reactions ut reactions in solution which take place within a omparatively narrow range of temperature. The evelopment of the theory of homolytic processes in solution is therefore generally recognized as an dvance of considerable importance.

Most text-books refer to the aliphatic hydrocarbons nd ethers as inert stable compounds, but it is now necessary to define more clearly what is meant by he word 'inert'. Such compounds are admittedly easonably inert towards typical anionoid and cationoid reagents, such as acids, alkalis, and the halogens, but this stability does not apply to all eagents. Further, the text-books state that when aliphatic acids or acid halides are mono-chlorinated, the chlorine atom invariably becomes attached to the carbon atom adjacent to the carboxyl group. This, however, is only true for chlorine *molecules*. If chlorine *atoms* are involved the halogen becomes attached to the carbon atoms some distance removed from the carboxyl group. Yet again, according to the text-books, a substituent group attached to an aromatic nucleus directs the entry of further substituent groups into specific positions in the molecule. Some groups direct to the *ortho* and *para* positions, while others direct predominantly to the *meta* positions. Such conditions, however, only hold when the substituting agent is of the anionoid or cationoid type. If the substituting agent is a free radical, the laws of aromatic substitution no longer hold and substitution takes place invariably at the *ortho* and *para* positions and in many cases at all three positions. Numerous further examples can be given which indicate to what extent the text-books of to-day require both supplementing and correcting.

The significance of the participation of free radicals of short life in reactions in solution was first brought to light as a result of the study of one or two little-known reactions which could not be accommodated within the accepted electronic theory. Gomberg and Bachmann[1] had shown in 1924 that, when benzene diazohydroxide was allowed to react with a neutral aromatic compound, the laws of aromatic substitution did not hold, and that whatever so-called directing group was present the product was always a mixture of the *ortho* and *para* isomerides, thus:

$$\mathrm{PhN:NOH} + R\mathrm{C_6H_5} \rightarrow o\text{- and } p\text{-}\mathrm{PhC_6H_4}R + \mathrm{N_2} + \mathrm{H_2O}$$

As a result of a study of this and a number of closely related reactions, it was concluded that free radicals were involved[2], and the fundamental properties of aryl radicals formed under these conditions were then established for the first time[3]. These may be summarized as follows:

(i) Reaction with aromatic compounds gives *ortho/para* substitution (or in some cases *ortho/meta/para* substitution):

$$\mathrm{Ph.} + R\mathrm{C_6H_5} \rightarrow o\text{- and } p\text{-}\mathrm{PhC_6H_4}R$$

(ii) Reaction with aliphatic hydrogen compounds involves removal of hydrogen:

$$\mathrm{Ph.} + R\mathrm{H} \rightarrow \mathrm{PhH}$$

(iii) Reaction with aliphatic halogen compounds involves removal of halogen:

$$\mathrm{Ph.} + R\mathrm{Hal} \rightarrow \mathrm{PhHal}$$

These results led to further work which established the important fact that, contrary to the views of earlier workers, acyl peroxides give rise on thermal decomposition to free radicals[3,4]. This observation provided a satisfactory explanation for the 'peroxide effect' for the abnormal addition of hydrogen bromide, mercaptans, and sodium bisulphite to ethylenic compounds, and led to the widespread use of benzoyl peroxide for the initiation of chain reactions in solution. Further, the use of benzoyl peroxide as a catalyst for addition polymerization falls into line with Staudinger's theory of polymerization; and the recognition of the part played by such peroxides as a source of free radicals has resulted in many fundamental advances in our knowledge of polymerization.

There are at least five different ways in which free radicals of short life can be generated in solution. These may be summarized as follows:

(i) Action of heat:

for example, $\mathrm{PbEt_4} \rightarrow \mathrm{Pb} + 4\mathrm{Et.}$

(ii) Action of light:

for example, $R\mathrm{CO}R' + h\nu \rightarrow R. + R'. + \mathrm{CO}$

(iii) Discharge of an ion at an electrode:

for example, $\mathrm{MeCOO^-} \rightarrow \mathrm{Me.} + \mathrm{CO_2} + e$

$(R_2\mathrm{MgBr_2})^{=} \rightarrow 2R. + \mathrm{MgBr_2} + 2e$

(iv) Irreversible disruption of a molecule with evolution of a stable gas:

for example, $\mathrm{PhN:N}X \rightarrow \mathrm{Ph.} + X. + \mathrm{N_2}$,

where X is OH, Cl or acyloxy.

$\mathrm{PhN:NCPh_3} \rightarrow \mathrm{Ph.} + \mathrm{Ph_3C.} + \mathrm{N_2}$

$\mathrm{(PhCOO)_2} \rightarrow \mathrm{Ph.} + \mathrm{PhCOO.} + \mathrm{CO_2}$

$\mathrm{(MeCOO)_2} \rightarrow \mathrm{Me.} + \mathrm{MeCOO.} + \mathrm{CO_2}$

(v) Reaction of Grignard reagents with a metallic halide:

for example, $R\mathrm{MgBr} + \mathrm{CoCl_2} \rightarrow R\mathrm{CoCl} + \mathrm{MgBrCl}$

$R\mathrm{CoCl} \rightarrow R. + \mathrm{CoCl}$

and $\mathrm{CoCl} + R'\,\mathrm{Br} \rightarrow R'. + \mathrm{CoClBr}$

With regard to the properties of free radicals in solution, it is important to recognize (*a*) that a free radical in solution will not necessarily behave in the same way as would the same free radical in the gaseous state, and (*b*) that the properties of free radicals, like the properties of molecules, depend primarily on their chemical composition and constitution. In general, a free radical in solution can act in one of three ways, thus:

(i) Dimerization:

$$2R. \rightarrow RR$$

(ii) Disproportionation:

$$2R. \rightarrow R{+}\mathrm{H} + R{-}\mathrm{H}$$

(iii) Reaction with the solvent:

Aliphatic solvent: $R. + R'\mathrm{H} \rightarrow R\mathrm{H}$

$R. + R'\mathrm{Cl} \rightarrow R\mathrm{Cl}$

Aromatic solvent: $R. + R'\mathrm{C_6H_5} \rightarrow o\text{- and } p\text{-}R'\mathrm{C_6H_4}R$

In many cases all three reactions may occur simultaneously, but the relative proportions in which the three types of reaction take place depend mainly on the nature of the radicals themselves and also, but to a much lesser extent, on their concentration.

The methyl radical, like the first member of most homologous series, behaves rather abnormally since it mainly reacts with the solvent. With ethyl, propyl and butyl radicals the disproportionation reaction becomes more prominent, but some reaction with the solvent also occurs. With the higher alkyl radicals, dimerization becomes the main reaction, and reaction with the solvent becomes negligible. In the cases of radicals with branched chains and hydroaromatic radicals, the main reaction is dimerization. With the benzyl radical, dimerization is again predominant but with longer side-chains attached to the aromatic nucleus, as for example in the β-phenylethyl radical, disproportionation is the main feature. With aryl radicals the predominant and often exclusive reaction is a reaction with the solvent, whether aliphatic or aromatic, and dimerization is very rarely encountered. The effect of concentration is generally to favour the dimerization reaction, as would be expected. When free radicals are formed by the discharge of ions at an electrode, the local concentration of radicals may become momentarily very high, and in these circumstances dimerization may be encountered with radicals, such as phenyl, which in solution normally show no tendency in this direction.

Many examples of interest could be quoted of the practical applications of reactions involving free radicals or atoms. The use of diazo and related reactions for effecting the union of nuclei has been extensively employed[5]. In the medicinal field may be mentioned the synthesis of 1 : 2 : 5 : 6-dibenzfluorene[6], the important tumour-inhibiting agent, the preparation of compounds in investigations on the constitution of cannabinol[7], and the synthesis of new spasmolytic agents in the pyridylquinoline series[8]. In the field of colouring matters the reactions for effecting the union of an aromatic nucleus with a pyridine nucleus have led to the preparation of tetrapyridylphthalocyanines[9], which, unlike the parent blue pigment, are bright green in colour and can give rise to water-soluble quaternary salts which show affinity for cotton and viscose fibres, thus providing dyestuffs of the phthalocyanine series.

The capacity of benzoyl peroxide to yield free radicals provides the basis for many chain reactions in solution which result in halogenation and carboxylation reactions of an unusual type. Kharasch has shown that in presence of benzoyl peroxide, sulphuryl chloride acts as a chlorinating agent for paraffins, aromatic side-chains and aliphatic acids[10]. These reactions proceed by means of chlorine atoms, and when this method is applied to the fatty acids or acid chlorides it is found that the carbon atoms some distance removed from the carboxyl group are preferentially chlorinated, as opposed to the normal process of α-chlorination[11]. In an analogous manner oxalyl chloride in presence of benzoyl peroxide can be used as a carboxylating agent for aliphatic and carbocyclic hydrocarbons[12]. Another reagent which is considered to give rise to a neutral halogen atom is N-bromosuccinimide, which brominates at the so-called 'allyl' position[13]. With this reagent *cyclo*hexene gives 3-bromo*cyclo*hexene, just as 3-chloro*cyclo*hexene is obtained from the reaction between benzene diazochloride and *cyclo*hexene and 3-phenyl*cyclo*hexene is obtained from benzoyl peroxide and *cyclo*hexene. A particularly useful application of this reagent is for the degradation of the side-chain in sterols and bile acids, which removes three carbon atoms in one stage, thus :

$$: CHCH_2CH_2CO_2Me \rightarrow : CHCH_3CH : CMe_2 \rightarrow$$
$$: CHCHBrCH : CMe_2 \rightarrow : C : CHCH : CMe_2 \rightarrow : CO$$

The application of this series of reactions to 3-hydroxycholenic acid has been used in a new synthesis of progesterone, the hormone of the corpus luteum.

The free radical derived by removal of bromi from anethole hydrobromide readily undergo dimerization with the formation of the dimeth ether of the valuable synthetic œstrogen hexœstrol[1 The free radical in this instance was prepared b means of the action of a Grignard reagent on anetho hydrobromide in presence of cobaltous chloride.

In the application of the chemistry of free radica to the subject of addition polymerization the resul have been particularly striking. The generall accepted theory of the mechanism of additio polymerization, put forward by Staudinger in 193 and since elaborated by others, involves the primar formation of an activated molecule, which the reacts with a second molecule to give an activate dimeride ; this in turn reacts successively wit further molecules in the same way until finally th active centres disappear, primarily by disproportiona tion or reaction with a solvent. The initial activate unit and the intermediate units in the building up o the polymer are free radicals. The acceptance o such a free radical mechanism necessarily implie that the polymers so formed should contain fragments of the catalyst, and, if polymerization is carried out in a solvent, fragments of the solvent molecules also. Further, compounds other than acyl peroxides, which are capable of giving rise to free radicals, should also be capable of initiating polysolvent molecules in the polymer.

The presence of fragments of the catalyst in the molecules of polymers is unmistakably revealed in a number of investigations in which substituted or 'marked' peroxides have been used, containing atoms or groups the presence of which can be readily confirmed by analysis. In the polymerization of styrene in the presence of 3 : 4 : 5-tribromobenzoyl peroxide, the resultant polymer contained 15 per cent bromine, which corresponds approximately to one tribromophenyl group for each polymer chain[15]. It has also been found that polystyrene prepared by polymerization with benzoyl peroxide always contains oxygen, and this has been shown to be due to the presence of benzoate groups, as would be expected from the presence of benzoate radicals. The polymerization of styrene is not accelerated by the presence of a nitrobenzoyl peroxide, and this is attributed to a direct reaction between the free radical and the nitro compound. It had already been established some years earlier that nitro compounds were among the most reactive aromatic compounds towards free radicals[3]. It has also been shown that if styrene is polymerized in presence of nitrobenzene the polystyrene formed contains nitro groups[16]. Nitrothiophene is even more reactive in this respect than nitrobenzene[17]. Other workers have shown that, when polymerization is effected in the presence of carbon tetrachloride, the resultant polymers contain chlorine[18]. These results illustrate the incorporation of fragments of the catalyst and of the solvent molecules in the polymer.

Numerous cases have been recorded of the initiation of addition polymerization by compounds other than acyl peroxides which can decompose to liberate free radicals. For example, polymerization can be effected by means of tetraphenylsuccinonitrile[19], benzeneazotriphenylmethane[20], benzene diazohydroxides[21] and nitrosoacylarylamines[22]. These investigations provide convincing evidence in support of the free-radical mechanism of polymerization and add considerably to our knowledge of the subject.

From the above examples it will be evident to hat extent reactions of the type under discussion ave now permeated many fields of organic chemistry. he obvious importance of these developments, both rom the theoretical and practical points of view, ndicates that the time is approaching when it will ecome necessary to reconsider the manner in which he subject of organic chemistry is presented to the tudent. In the past the teaching of organic chemistry as been founded to a very large extent on the almost niversal and invariable tetravalency of carbon. The ewer approach must embrace not only the reactions f the tetravalent carbon molecule but also those of he trivalent carbon radical. It is also pertinent to ecall that in the past the raw materials for the rganic chemical industry have been derived almost xclusively from coal, but at the present time raw materials are also provided in ever-increasing quantity from the by-products of the petroleum industry. These raw materials, primarily hydrocarbons of various types, are frequently compounds normally regarded as inert, but which are by no means so inert towards reagents which give rise to free radicals or atoms. It is therefore to reactions of this type that we must look in order to develop fully the new resources now placed at our disposal. For these reasons I have chosen to include such reactions, not, it is hoped, entirely without justification, under the title of "The New Organic Chemistry".

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AN EXPERIMENTAL TREATMENT OF THE APICAL MERISTEM IN FERNS

By Prof. C. W. WARDLAW
University of Manchester

In *Dryopteris aristata* an attempt has been made to observe the effect of isolating the apical meristem from the adjacent lateral tissues, while maintaining continuity with the pith parenchyma below. The first step was to ascertain the practicability of the operation. The procedure involves an operation roughly comparable with 'ringing' in an older region of the shoot, in that the incipient vascular tissue is severed. The difficulty lies in the fact that the treatment has to be applied to a minute region—the meristem—the tissue of which is soft, delicate and readily injured. Thereafter it remained to be seen whether a meristem so treated would prove capable of further growth. The successful outcome of such an experiment seemed likely to throw light on (1) morphogenetic processes at the shoot apex; (2) translocation of nutrients to the shoot apex; that is, whether this takes place by way of the undifferentiated vascular tissue or by upward diffusion over the whole cross-sectional area of the shoot; (3) the factors influencing the differentiation of the vascular system; that is, whether the effective stimuli proceed basipetally from the apex or acropetally from the older pre-formed parts; and (4) the physiological dominance normally exercised by the shoot apex over lateral buds or bud-primordia.

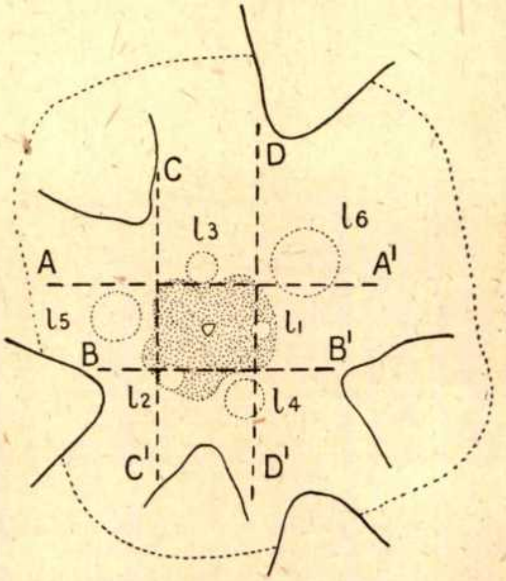

Fig. 1. Downward view of a small apex of *Dryopteris aristata* showing the apical meristem (stippled) and a succession of young leaf primordia (l_1, l_2, etc.). The system of vertical incisions by which the apical meristem is isolated from adjacent lateral tissues is indicated. (× 54.)

For these experiments the common broad-shield fern *Dryopteris aristata* was selected, plants of all sizes being obtainable in abundance. Previous experience has indicated that this species possesses very considerable vitality under experimental treatment.

An apex of *D. aristata*, as seen in longitudinal median section, may, for convenience, be considered to include three regions in basipetal sequence: (1) the apical meristem which consists of a single

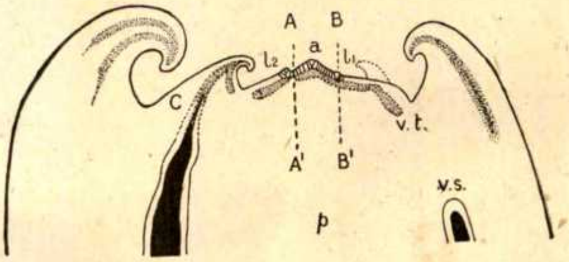

Fig. 2. Longitudinal median section of a large apex of *D. aristata* showing the isolation of the apical meristem by vertical incisions. (× 6.)

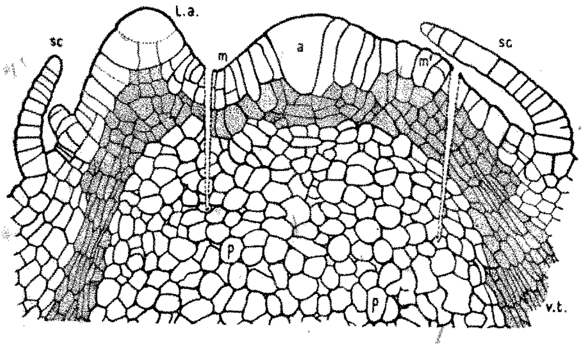

Fig. 3. LONGITUDINAL MEDIAN SECTION OF A SMALL APEX OF *D. aristata* SHOWING THE DETAILS OF AN ISOLATED MERISTEM. *m—m'*, APICAL MERISTEM, WITH LARGE APICAL CELL, *a*; *sc*, SCALE; *l.a.*, LEAF APEX; *v.t.*, VASCULAR TISSUE IN INITIAL PHASE OF DIFFERENTIATION; *p*, PITH. THE VERTICAL INCISIONS ARE SHOWN: THE ISOLATED MERISTEM IS CONTINUOUS WITH A THIN SHEET OF INCIPIENT VASCULAR TISSUE AND MEDULLARY PARENCHYMA. (× 100.)

layer of superficial cells, including the apical cell, of distinctive appearance and chemical reaction; (2) the region of initial differentiation, in which leaf primordia, buds and scales originate superficially from cells within or on the margin of the apical meristem and in which stele, cortex and pith can first be distinguished internally; and (3) the region of subsequent differentiation which merges downwards with the fully matured tissue systems. It should be noted that the incipient vascular tissue can be traced upwards to the region of its inception immediately below the apical meristem. Since the principal initial developments take place in region (2), it is there that experimental treatments must be applied.

The first step is to have unimpeded access to the apical meristem. At first sight this does not appear to be a very feasible undertaking. Indeed, because of the large number of rolled leaves and leaf primordia in the terminal bud and the dense investment of scales, the apices of ferns have not generally commended themselves as providing favourable materials for experimental investigations. Nevertheless, it is a fact of experience that there is little difficulty in removing the scales and leaf primordia from stout shoots of *D. aristata* or *D. filix-mas* and thereby laying bare the apical cone. These operations are carried out by means of small pointed scalpels and forceps, the material being observed under a binocul microscope. A downward view of a small shoot ap is illustrated diagrammatically in Fig. 1.

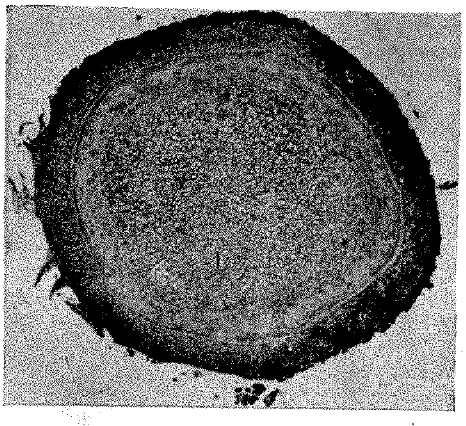

Fig. 4. SOLENOSTELE PRESENT IN THE SHORT AXIS DEVELOPED FROM AN ISOLATED APICAL MERISTEM. (× 20.) (*Photos* 4–7 *by E. Ashby.*)

To isolate the apical meristem from the adjace lateral tissues, and to sever the incipient vascul tissue, the following procedure was adopted. T terminal region of a stout shoot, trimmed to a leng of about 2–3 cm. and defoliated as already describe was observed under a binocular microscope at magnification of fifty times. By means of a smal thin-bladed scalpel four vertical cuts were made such a way as to isolate the apical meristem, on little square island of tissue, as indicated in Fig. In longitudinal section it will be seen that the isolate apical meristem, together with a thin layer incipient vascular tissue, is seated distally on plug of developing medullary parenchyma (Figs. and 3).

The system of incisions described above is obviousl only one of many that may be applied. For example the vertical cuts may be made on the margin of th apical meristem, within the margin, or outside it, s as to include one or more leaf primordia, and so on.

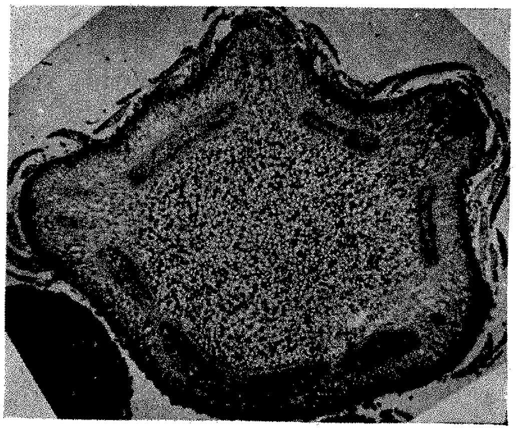

Fig. 5. DICTYOSTELE PRESENT IN THE TERMINAL FOLIAR REGION OF AN AXIS DEVELOPED FROM AN ISOLATED APICAL MERISTEM. (× 11.)

Again, leaf primordia of different ages may be isolated on separate plugs. I have found that isolating by four vertical cuts is simple and least damaging to the apical meristem, but other patterns, for example, by three cuts, are also possible. Radial cuts diverging from the margin of the apical meristem have also been made with interesting results. The procedure can be further varied by cutting more or less deeply into the tissue. In passing, it may be noted that the small size of the meristem precludes the use of a cork borer. The experimental and control plants were planted in moist peat in a cool greenhouse.

The isolated meristem is capable of growth. It develops into a short axis and in the course of four weeks may develop three or four new leaf primordia. In the course of three months, one specimen had developed a compact terminal bud in which fourteen leaf primordia were counted. In relation to the severance of the vascular tissue, the lower region of the axis consists entirely of medullary parenchyma. Higher up, a solenostele is present (Fig. 4). Still higher up, in the region of leaf development, the vascular system becomes dictyostelic (Fig. 5). The new leaves in the materials so far examined show normal

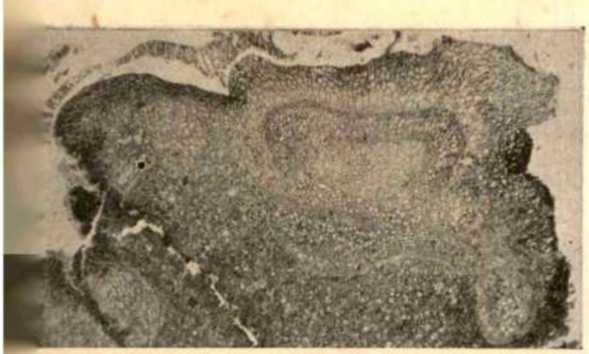

Fig. 6. TRANSVERSE SECTION OF A LATERAL SEGMENT OF AN INCISED SHOOT, SHOWING THE LARGE SOLENOSTELE OF A BUD CONJOINED WITH A MERISTELE OF THE PARENT SHOOT. (× 22.)

hyllotaxis and this is apparently in continuity with hat of the parent shoot. Whereas lateral buds evelop rapidly on the surrounding segments of the arent shoot, the new terminal axis is devoid of uds.

The lateral segments of the shoot are characterized y the development of very large axillary solenostelic uds (Fig. 6); they are thus in marked contrast to uds on the normal shoot, in which a small, nonmedullated protostele is present. Individual unifferentiated meristeles, isolated in lateral plugs as result of the system of incisions adopted, also show ome remarkable and hitherto undescribed developments, such, for example, as the development of olenostelic structure (Fig. 7).

Individual leaf primordia, isolated on plugs, undergo limited development only, and show a tendency o be thrust aside by more strongly growing axillary buds. In contrast to the normal development, in which the foliar conducting system consists of six to eight separate vascular strands disposed horseshoe fashion, the vascular system of an isolated leaf primordium is solenostelic.

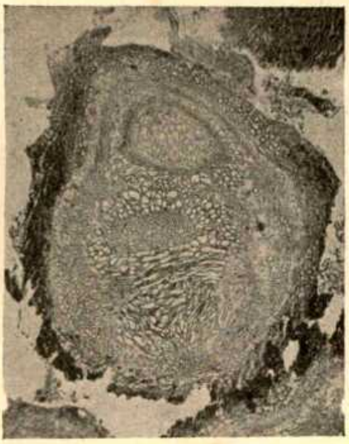

Fig. 7. TRANSVERSE SECTION OF A LATERAL SEGMENT OF AN INCISED SHOOT SHOWING THE SOLENOSTELE OF A BUD (TOP) CONJOINED WITH A MERISTELE WHICH HAS BECOME MEDULLATED (CENTRE); THE COMPACT MASS OF TRACHEIDES (BOTTOM) PERTAINS TO A SECOND MERISTELE OF THE PARENT SHOOT. (× 30.)

Thus, by using the technique described, many new and interesting observations have been made. These will be fully described and discussed elsewhere in due course. The answers to some of the questions raised in the opening paragraph are evident from the data submitted.

OBITUARIES

Dr. Stanley W. Kemp, F.R.S.

MARINE biology has suffered a heavy blow through the death on May 16 of Dr. Stanley Wells Kemp, and the loss of a wise and generous friend will be deeply felt by all who were associated with him. He rendered distinguished services to the Irish fisheries, the Zoological Survey of India, the Discovery Committee and the Marine Biological Association, and did much to stimulate marine research in Great Britain and overseas.

Kemp was born on June 14, 1882, the son of Stephen Kemp, and was educated at St. Paul's School and at Trinity College, Dublin. In 1903 he was appointed assistant naturalist in the Fisheries Branch of the Department of Agriculture and Technical Instruction of Ireland. In this post he gained a thorough practical knowledge of marine zoology, especially of the Caridea. He acquired valuable experience in deep-water investigations, and published several papers in the "Scientific Investigations" of the Department. This was followed by a period of fourteen years in India (1910–24), where he was first appointed senior assistant superintendent of the Zoological and Anthropological Section of the Indian Museum (which later became the Zoological Survey of India). Here he specialized in the study of Crustacea and began his "Notes on Decapoda in the Indian Museum", a valuable series of publications which continued until 1925. In 1916 he became first superintendent, under Dr. Annandale, of the Zoological Survey, and it is generally recognized that he and Annandale established an exceptionally high standard of zoological research in India. He accompanied various expeditions to study the fauna in different parts of India, including the expedition to the Abor country in 1911–12 (where he discovered the new genus *Typhloperipatus williamsoni*); and in 1922 he carried out the exploration of the Siju Caves in the Garo Hills. In 1916 he was elected a fellow of the Asiatic Society of Bengal, and in 1918 he brought out the important "Catalogue of Scientific Serial Publications in the Principal Libraries of Calcutta". While on leave in the following year, he took the degree of Sc.D. of Trinity College, Dublin, and visited the principal zoological centres in Europe with the view of establishing a marine biological station in the Andaman Islands.

Kemp was appointed director of research to the Discovery Committee in 1924, and it was under his far-sighted leadership that a well-equipped and many-sided organization was built up. The investigations were to include research on the general biology of whales (for purposes of the rational regulation of the whaling industry) and on other natural resources of the Falkland Islands Dependencies, and they involved an oceanographical survey of Antarctic waters, with attention to many subsidiary matters such as surveying and general collecting. This was an enterprise of a new kind which could be guided only to a limited extent by previous experience; but Kemp's remarkable capacity for organization in detail and his mastery of technical problems overcame all difficulties. Early in 1925 the Marine Biological Station was established at South Georgia, mainly for direct observations on whales. In the same year the *Discovery* (Scott's old ship, refitted for oceanographical research) sailed from England and shortly afterwards there followed the *William*

Scoresby, designed for whale-marking, experimental trawling, and general oceanography. The *Discovery II* which sailed in 1929 on the first of her five commissions was designed and equipped according to the requirements laid down by Kemp, and after the experience gained in voyages extending over nearly ten years, it would be difficult to devise any major improvements. The high standard he set in everything was also evident in the style of the Discovery Reports, of which the first volume appeared in 1929. Kemp sailed in the *Discovery* (1925–27) and *Discovery II* (1929–31) and at other times worked at his headquarters in London. It was under his direction that a new field of research was opened up which has led to much knowledge of whales and related subjects, and of the Southern Ocean in general, and which has in many ways advanced the science of oceanography.

In 1931, Kemp became a fellow of the Royal Society. For a time he was an honorary secretary to the Linnean Society, and in 1936 he received the Victoria Medal of the Royal Geographical Society. It was in 1936 also that he was appointed secretary to the Marine Biological Association and director of the Plymouth Laboratory. Here he found fresh scope for his administrative ability and capacity to stimulate research. He became the leading figure in marine biology, and much as he did to further the interests of the Laboratory, he was in contact also with the Discovery Committee, of which he remained a member, and kept in touch with his colleagues in India and Ireland. During the War his advisory activities were of great value, especially in the preparation of post-war investigations, and in this field his opinion carried much weight with the Colonial Fisheries Advisory Committee, the Development Commission, and the English and Scottish Fisheries Departments. He also sponsored investigations on seaweeds which arose from the war-time need for alginic acid.

In 1940 and 1941 the Plymouth Laboratory suffered heavily from enemy action, and though his own home and its contents were wrecked, it was largely through Kemp's personal initiative that the Laboratory was saved from complete destruction. He found safe accommodation for the valuable library, and instituted all possible repairs; and he had worked out comprehensive plans for the alteration and enlargement of the Laboratory in anticipation of peace-time requirements.

He married, in 1913, Agnes, daughter of the Rev. W. Spotswood Green, and had a daughter. In his home life Dr. Kemp enjoyed working with his hands, for he was a fine craftsman, and he found much pleasure as a collector of insect life. He was a man of modest nature with a keen sense of humour; his personality inspired great confidence and respect, and he had a shrewd understanding of human nature and a sense of values which was never led astray by the false or superficial. Those who sought his advice on professional or personal problems were never disappointed, for his judgment was always manifestly sound and sensible. It was an education to work under him, and he will be remembered with gratitude and affection by his many friends.

N. A. MACKINTOSH.

Prof. Eugène-Louis Bouvier

IT has recently become known in Britain that Prof. E.-L. Bouvier, for many years head of the department of articulate animals at the Musée National d'Histoire Naturelle de France, and later professor of entomol there, died near Paris on January 14, 1944. He w born on April 9, 1856, joined the Paris Museum 1883, and remained there for the remainder of active life, except during the years 1889–95, when was professor at the School of Pharmacy in Paris. 1902 he was elected to the Academy of Sciences, a became president in 1925. He received numer other distinctions both at home and abroad, and w a foreign member of the Linnean Society and t Zoological Society of London.

Bouvier's activities extended over an extraordi arily wide range of subjects. His earlier works inclu memoirs on Mollusca and Cetacea, and his well-kno monograph on *Peripatus*. Shortly after joining t Museum he became especially interested in t Decapod Crustacea, and his researches on this gro continued to the end of his life, Bouvier's last wor published in 1942, being devoted to the Corystoide His monograph on the Atyidæ is one of the bes known of his many studies on Crustacea. He al completed a monograph of the Pycnogonida.

While on a visit to Plymouth in 1913, he ma the interesting discovery (*Nature*, **91**, 633) of t transformation of the Phyllosome larva into t Puerulus stage of the common lobster.

Bouvier first became interested in the habits insects about 1900, and published studies on th psychology of certain Hymenoptera. In later year he devoted most of his time to entomology, and bui up an active department in this subject at th Museum. His general works on the subject includ "Habitude et Metamorphoses des Insectes", "L Communisme chez les Insectes", and "La vie psychiqu des Insectes", the latter, translated into English b Dr. L. O. Howard, being perhaps his best-know work in Great Britain. After retiring from th Museum, he continued to work on insects and during 1931–38 published six memoirs on the Saturnii moths.

Prof. Bouvier began his active career at a time when evolutionary doctrines were still being contested. He was a student of Edmond Perrier, and as a result of this influence his work was mainly directed to studies on the adaptive evolution of characters in various groups of animals and attempts to elucidate their phylogeny. He was a most enthusiastic research worker and knew how to communicate his interest to others. He became one of the best-known personalities in the scientific world of Paris, and his death removes one of the last links with the great French zoologists of the nineteenth century.

E. HINDLE.

WE regret to announce the following deaths:

Prof. E. Barclay-Smith, emeritus professor of anatomy in the University of London, on July 5, aged eighty-three.

Sir William Ellis, G.B.E., president during 1924–25 of the Iron and Steel Institute and during 1925–26 of the Institution of Civil Engineers, on July 4, aged eighty-four.

Dr. Robert E. Horton, hydraulic consultant to the Tennessee Valley Authority, and a member of the Institution of Civil Engineers, on April 22, aged sixty-nine.

Mr. A. G. Hastings White, C.B.E., honorary consulting librarian to the Royal Society, on July 8, aged eighty-one.

NEWS and VIEWS

Prof. Major Greenwood, F.R.S.

PROF. MAJOR GREENWOOD's retirement from the chair of epidemiology and vital statistics in the University of London marks the close of an epoch. Beginning his professional career as a physiologist at the London Hospital Medical College, the study of vital statistics early appealed to him. In addition to making advances in the mathematical study of the subject, he applied his knowledge as a touchstone to medical investigation. As statistician to the Lister Institute and, later, as chairman of the Statistical Committee of the Medical Research Council, his severe and wise scrutiny of data gave medical statistics a new meaning and elevated the standards of research into countless medical problems. During the War of 1914–18, he was in charge of the Medical Research Subsection of the Ministry of Munitions. "The Health of the Industrial Worker", written with Prof. Collis, records much of this work. The London School of Hygiene and Tropical Medicine was fortunate in securing his services in 1926, and he was made a fellow of the Royal Society in 1928. At the London School of Hygiene he soon gathered around him a band of workers trained in his special methods, while his teaching was highly valued by his students.

Prof. Greenwood's investigations with the late Prof. W. W. C. Topley wedded experimental epidemiology to statistical interpretation, and his book on "Epidemics and Crowd Diseases" further enhanced his reputation. The Royal Statistical Society made him its president, and he has enriched its proceedings by many medical and historical papers, which are models of English prose, adorned by wit and incisive epigram. It is not too much to say that Prof. Greenwood's work has revolutionized epidemiology and medical statistics, for he has ever been a searcher after truth and has shattered a multitude of false doctrines which impeded progress. It is satisfactory to know that his pupils—many of whom occupy influential positions—will carry on the torch which he has so successfully kindled. He vacates his chair not only with the regret of all who appreciate his great qualities as pioneer and teacher, but also assured that his work has added considerably to the sum of human knowledge.

Mr. M. A. C. Hinton, F.R.S.

MR. M. A. C. HINTON retired from his position as keeper of the Department of Zoology, British Museum (Natural History) on June 29. He has been associated with the Museum for many years, becoming a voluntary worker in 1910 and an assistant in the Mammal Section in 1921. He was promoted to deputy keeper in 1927 and took charge of the Zoology Department in 1936. His official work has, of necessity, involved most of the mammalian orders, but his principal contributions have been to the knowledge of the Rodentia. Numerous smaller papers, many of them with special reference to the species occurring in the Pleistocene of southern England, culminated in 1926 in the publication of the first volume of his monographic work on "Voles and Lemmings (Microtinæ) Living and Extinct".

But Mr. Hinton's interests have by no means been restricted to the purely taxonomic aspects of his subject. He has given considerable attention to the economic significance of rodents as enemies of man. His investigations into the musk rat menace in Britain entailed long, arduous periods in the field both in England and Germany. The order Cetacea has also attracted Mr. Hinton's attention. He prepared the report for the Interdepartmental Committee on Whaling from the papers left by Major Barrett Hamilton, who died while making investigations in South Georgia. This report is the foundation of much that was done eventually to ensure that whaling is carried out in a way least harmful to the stock from which the catches are made. It is hoped that Mr. Hinton, freed from the routine of an official post, will enjoy a long and active retirement, and that it will give him the opportunities he has long sought to concentrate on those zoological problems which, with his great knowledge and experience, he should do so much to elucidate.

Sir D'Arcy Thompson and Oxford

ON June 28, Sir D'Arcy Thompson, professor of natural history in the University of St. Andrews, was awarded the honorary degree of doctor of civil law by the University of Oxford. In presenting him to the vice-chancellor, the public orator (Mr. T. F. Higham) said that science and the classics each claim Sir D'Arcy as their own : as doctor of civil law, Sir D'Arcy will himself now be empowered to settle their rival claims. Mr. Higham also stressed the point that Sir D'Arcy has achieved the distinction, never more to be rivalled, of having been for no less than sixty years a professor. On the evening of the same day, Sir D'Arcy was the guest at a dinner party at which the announcement was made of a presentation volume of essays written in his honour, to be published very shortly by the Clarendon Press. Apart from contributors to the volume, there were present the vice-chancellor, Sir David Ross, Prof. E. S. Goodrich, Sir Henry Tizard, Prof. A. C. Dixon and Mr. Kenneth Sisam; and telegrams of congratulation received from many parts of the world were read.

Aeronautical Engineering at Bristol : Prof. A. R. Collar

MR. A. R. COLLAR has been appointed to the White chair of aeronautical engineering recently endowed in the University of Bristol by the Bristol Aeroplane Company ; he will take up his appointment on his release from national service. Mr. Collar was educated at Simon Langton School, Canterbury, and at Emmanuel College, Cambridge, taking honours in mathematics and physics ; he also took an honours degree in physics of the University of London. In 1929 he joined the staff of the Aerodynamics Department of the National Physical Laboratory, where he remained until the beginning of the War, since when he has been specially attached to the staff of the Royal Aircraft Establishment at Farnborough. At Teddington he carried out a wide range of aeronautical investigations, of which those affecting wind-tunnel design and aeroplane flutter problems are probably the most generally known. He is the author of many reports published by the Aeronautical Research Committee, and was for some time secretary of the Airscrew Panel and the Fluid Motion Panel of that Committee. Mr. Collar went to Farnborough to take charge of a special group of scientific men and engineers investigating aeroplane flutter and vibration problems. Working in close contact with aeroplane designing firms, this group has contributed notably to the safety of British aeroplanes.

New Stratosphere Aircraft

INFORMATION has just been released regarding a twin-engine stratosphere single-seater fighter, the Westland "Welkin", designed to deal with high-flying raiders. It is a mid-wing monoplane of 70 ft. span, weight 17,500 lb., single tail, and generally of conventional aerodynamic form. It is powered by two Rolls-Royce Merlin engines, of 1,650 h.p. each, fitted with two-stage two-speed superchargers sufficient to maintain the power at exceptionally great heights. Rotol four-bladed constant pitch airscrews are used, giving a speed of 385 miles per hour with a range of 1,500 miles. Its armament consists of four cannon, and the pressure cabin is fully armoured.

It is appropriate that this, the first stratosphere fighter to be adopted by the R.A.F. as a standard type, should have been designed and produced by the Westland Aircraft Co., which has specialized in the problem of high flying and was responsible, in pre-war years, for the equipment of the Mount Everest flying expedition. Many problems upon the design of pressure cabins have been solved in the experimental work on the "Welkin" that will be equally important to civil aviation. The automatic regulation of the air pressure is done by a valve developed by the firm, which is already being used on many other aircraft. Cabin heating and the avoiding of ice and mist formation on the windows is done by means of a 'heat sandwich'; warm air is pumped between two layers forming the pressure-resisting surface of the cabin, the same air circulating in the cabin and cockpit space. The temperature control has been found to be such that no special clothing was needed even at an outside temperature of – 78° F. At ordinary altitudes, either lower temperature than outside can be maintained or even cooled air can be circulated.

Geography in New Zealand

DURING recent years the study of geography has won recognition in most of the colleges of the University of New Zealand, and in 1944 a New Zealand Geographical Society was founded in Wellington with branches in the other main cities of the Dominion. This Society has now issued the first number of its journal under the title of the *New Zealand Geographer*, from its publishing office at Canterbury University College, where the idea of the Society was born. The journal, which is to appear twice a year, is to be concerned primarily, but not exclusively, with aspects of New Zealand, and is for home and overseas readers. The first number is devoted entirely to New Zealand topics and is written wholly by New Zealand contributors. Among several important articles is one by Mr. P. D. Sears on the regional variety of pasture growth in New Zealand. Since the country is primarily agricultural with chief interests in grazing, this study of the varying conditions of pasture growth is of much value. Another useful article is by Prof. C. A. Cotton on the geomorphic provinces in New Zealand. The *New Zealand Geographer* is well produced and promises to be a useful addition to geographical serials.

Bibliography of British Industry

A SELECT Bibliography on "British Industry and Commerce: Its History and Reconstruction" has been issued by the Sheffield City Libraries, to which Lord Riverdale contributes an introduction paying a deserved tribute to the services rendered to industry in the Sheffield district by the Science and Technology Library of the Sheffield City Libraries. The value of this service is well known to the research workers of the larger firms; but Lord Riverdale points out that Sheffield has in its Central Library one of the most valuable and effective research libraries on iron and steel in Great Britain. The bibliography is not limited to books and pamphlets but includes articles appearing in the more important reviews and scientific or technical periodicals during the last three years. Sections on Government and industry, effects of science and inventions on Society, statistical records, location and planning of industry, industrial research, research and education, British trade and commerce, finance and monetary reform and social security are included, but the bulk of the entries are arranged in the three subsections, history, pre-war organization and reconstruction, under the sectional heading British Industries and Public Services. The only important omission in the history subsection appears to be Sir John Clapham's recently published history of the Bank of England, but the absence of historical records of even large firms is noteworthy. The bibliography is admirably produced and printed; it faithfully reflects the trend of current thought in the fields covered and can be commended as an excellent basis for wider reading and study by those who wish to gain a clearer knowledge of the social and economic background in which scientific and technical research and industrial development proceed.

Azerbaijan Academy of Sciences

JACOB GIK, writing from Moscow, states that an Academy of Sciences has now been founded in Azerbaijan. Prior to its establishment, the Republic had a branch of the Moscow Academy, with twenty-two research institutes, etc. The new Academy has four main departments: agriculture, biology, geology and chemistry of oil, physics and technology of oil, together with a department of social sciences. The natural resources of Azerbaijan are now well known. Immense oilfields have been discovered and are now being developed. Geologists are investigating deposits of chromite, barytes and cobalt. The efforts of Russian men of science have made the province to a large extent independent of imported materials and enabled industry to carry on its work during the War without serious interruption. Physicists did particularly valuable work during the War. The Institute of Botany has published a comprehensive scientific work: "Agricultural Raw Materials of the Soviet Union". The Institute of Zoology is doing intensive work on problems connected with the effort to increase the yield of cotton, to rationalize the use of winter pasture lands, and to employ suitable local mineral fertilizers. A history of the literature of Azerbaijan from ancient times has just been published in two large volumes. The statutes of the Academy have been approved and fifteen well-known savants have been named as its first members.

Royal Society of Edinburgh

AT the ordinary meeting of the Royal Society of Edinburgh on July 2, Sir William Wright Smith, president, presented to the Society, on behalf of the subscribers, a bronze portrait head, by Benno Schotz, of Sir Edmund Whittaker, president of the Society during 1939–44. A copy will also be presented to Sir Edmund Whittaker. Mr. Stanley Cursiter presented to the Society a copy of his portrait of Sir

William Wright Smith. The Gunning Victoria Jubilee Prize (1940–44) was presented to Prof. H. W. Turnbull, regius professor of mathematics in the University of St. Andrews, and the Makdougall-Brisbane Prize (1942–44) jointly to Prof. Max Born, Tait professor of natural philosophy in the University of Edinburgh, and Dr. H. W. Peng. After the presentations Prof. Sydney Chapman, at the request of the Council and in terms of the Bruce-Preller Lecture Fund, addressed the Society on "The Earth's Magnetism".

Blackwell Prize and the Senior Hume Brown Prize in Scottish History

Two scientific workers, well known in the fields of scientific history and social technology, have just been awarded two unusual distinctions. Dr. Archibald Clow, of the Department of Chemistry of the University of Aberdeen, has been awarded the Blackwell Prize for a study of chemical contributions to industrial development. Dr. Clow and his wife, Nan L. Clow, have been carrying out research for several years on the contribution of chemistry to human welfare and development in the era of the industrial revolution, and the manuscript of the book in which they have embodied the results of their researches has been judged an outstanding contribution to history by the University of Edinburgh, which has awarded them the senior Hume Brown Prize in Scottish history. Both authors are graduates in arts and science of the University of Aberdeen, and Mrs. Clow particularly is well known for her contribution to the development of the scientific film society movement. Dr. Clow is a member of council of the Scientific Film Association. Dr. Clow is now working with the B.B.C., where he is taking charge of scientific broadcasts in a new programme to be produced in the early autumn.

Awards of the Veterinary Educational Trust

The Council of the Veterinary Educational Trust has awarded a Senior Wellcome Fellowship for Veterinary Research to Mr. Christopher W. Ottaway. After qualifying in December 1931, Mr. Ottaway was in veterinary practice for three years. He then entered the Anatomy Department, Royal Veterinary College, as a demonstrator and is now senior assistant in the Department. He has worked in the School of Veterinary Anatomy, Leipzig, and in the Department of Anatomy, Brno University Veterinary School, and has published a number of papers on anatomical problems concerned with domestic animals. His research work under the fellowship will be conducted at the Zoological Laboratories, University of Cambridge, and will be concerned with an investigation into the mechanics of the limbs of domestic animals and the factors which predispose to lameness and other diseased conditions.

The Council has also awarded a Wellcome Fellowship for Veterinary Research to Mr. Herbert Williams Smith. Mr. Williams Smith qualified in 1941 and has spent two years in private practice as an assistant. Since 1943 he has been an assistant veterinary investigation officer at the University College of North Wales, Bangor. He has contributed to the technical Press on the examination of milk samples for mastitis, and on the coagulase test for staphylococci. He has recently completed the examination of more than two hundred strains of staphylococci of animal origin with particular reference to determining criteria of pathogenicity. His research under the award will be concerned with the epidemiology of staphylococcal infections in animals, and will be conducted under Prof. G. S. Wilson at the London School of Hygiene and Tropical Medicine.

Conference on Automatic Controlling and Recording of Chemical and Other Processes

The Institution of Chemical Engineers, the Institute of Physics and the Chemical Engineering Group of the Society of Chemical Industry announce that the one-day joint conference on "Instruments for the Automatic Controlling and Recording of Chemical and Other Processes", which was postponed in September last, will take place at the Royal Institution, London, on October 19, 1945. The purpose of the conference is to promote the interchange of knowledge and experience between those using automatic controllers and recorders in different fields and to encourage collaboration between physicists and chemical engineers. The conference will be open without charge to all interested, whether members of the organizing bodies or not. Further particulars will be sent in September to those sending a request for them to the Organizing Secretary, Joint Conference, c/o the Institution of Chemical Engineers, 56 Victoria Street, London, S.W.1. As there have been so many changes of address, those who previously asked for further particulars are asked to repeat their request.

Announcements

Sir Lawrence Bragg is lecturing in Paris at the Sorbonne, under the auspices of the British Council, on "X-Ray Analysis, Past, Present and Future", "The Strength of Metals", and "X-Ray Optics". The visit was arranged in response to a request from French men of science. These lectures conclude a series arranged by the British Council in France since February, but the Council is assisting the British Institute in Paris in making arrangements for future lecturers.

Mr. A. L. L. Baker has been appointed to the University chair of concrete technology tenable at Imperial College of Science and Technology. During the War he has been consultant to the War Office and Admiralty for marine works, and since March 1945 he has been employed in the Chief Scientific Adviser's Division of the Ministry of Works.

Dr. E. W. Smith has been elected president of the Institute of Fuel for the year ending October 1946; this will be his third year of office. Mr. J. F. Ronca, member of Council, has been elected honorary secretary of the Institute.

A British Medical Exhibition arranged by the British Council was opened at the Sao Jose Hospital in Lisbon last month by the Portuguese Under-Secretary for Education. The Exhibition includes books and instruments, and British medical films have been shown. The Portuguese Minister of Education sent a message paying tribute to the work of the British Council and its institutes in Portugal, and expressing the hope that more such exhibitions would be arranged.

Erratum.—The author of the communication "Naga, Naja, Naia or Naya ?" published in *Nature* of April 14, p. 457, is W. V. D. Pieris, not "Picris" as printed; throughout the note, the word 'Singhalese' should be 'Sinhalese'.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Animal Learning and Evolution

Ever since the original enunciation by Baldwin[1] in 1896 of the theory of 'organic selection', the suggestion that local differences of habit (local 'traditions' as Elton[2] has termed them) may be the starting point for the evolution of new species of animals has been from time to time put forward in various forms. Such habit 'traditions', if entirely of a phenotypic nature, can of course only exist in animals in which there is some ability and opportunity for perpetuation of a particular type of behaviour or attachment to a particular environment or locality by means of associative conditioning, imprinting, or some other type of learning. Many peculiarities of behaviour which appear to be of this kind are known to naturalists; particularly to those who study such subjects as host selection of phytophagous and parasitic insects or the local variation in behaviour of birds (for example, song, nest-site, feeding habits, etc.). Many examples will be found in recent publications (refs. 3–8). That they may be very constant and persistent is suggested by the fact that, in a number of cases, highly characteristic and constant behaviour patterns of birds (such as song type), usually regarded as typical examples of specific characters, are now known to be, in part at least, transmitted from generation to generation by learning.

But while the idea that certain differences of this kind may be of evolutionary significance has proved attractive to various writers, it has been difficult, without invoking some form of Lamarckism, to visualize the mechanism whereby behavioural differences characteristic of local populations could become genetically fixed. It is true that the Sewall Wright effect might be operative in small populations; but recent criticism by Mather[9] makes the probable significance of the Sewall Wright effect appear less; and in any event Wright's theory, while it might provide for random change, would not of itself favour the genetical fixation of variation of the same kind and *in the same direction* as the pre-existing behavioural trend based on learning.

Huxley suggests (ref. 6, p. 524) that the organic selection principle might be expected to account for the replacement of non-heritable variations by 'mutations' (presumably merely on account of the increased adaptation to the niche thus conferred), and that "where the modifications are extensive the process of their replacement by mutations may closely simulate lamarckism". The object of the present communication is to suggest that recent developments in genetics and in the field of animal learning, particularly the concept of imprinting due to Lorenz and others (refs. in Thorpe[4]), make the principle at once more probable and easier to understand.

Mather[9] has pointed out that the kinds of character which are likely to distinguish races and species are polygenic, and that any small decrease in mating freedom between two populations, whether brought about by natural obstacles or by any other cause, will be sufficient to lessen the intensity of selection for good 'relational balance'. The result of this will be that when members of two such populations or strains cross, the offspring will be heterotic. Mather further brings forward evidence to show that heterotic individuals are often less fit than the parental types, and that the avoidance of heterosis is probably the most widespread stimulant of isolating devices. Such a system, once started, would be self-propagating and irreversible.

Suppose for the sake of argument that the initial basis of separation is a host-plant preference based on olfactory conditioning, or a 'locality imprinting' holding the animal to a restricted locality or environment[4], renewed afresh in each generation. Suppose also that this is strong enough and has continued long enough significantly to reduce the intensity of selection for relational balance. There will thus be a definite selective advantage for such new variants as favour more complete isolation. Among new germinal variants of equal magnitude, those which are of the same nature and direction as the phenotypic learned response already operating will, besides resulting in closer adaptation to the niche, be the most effective in furthering isolation, and will therefore be most strongly favoured by natural selection. Thus the learned or conditioned response of the animal to the environmental situation will, besides tending to reinforce and make effective slight topographical and geographical barriers, give momentum to, and set the direction for, the selective processes tending to bring about genotypic isolation. These selective processes will thus bring about the reinforcement and perhaps the eventual replacement of non-heritable modifications by genetic modifications, and will thus closely simulate a Lamarckian effect.

W. H. Thorpe.

Department of Zoology,
University,
Cambridge.
May 4.

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[1] Baldwin, J. M., *Amer. Nat.*, **30**, 441, 536 (1896).

[2] Elton, C., "Animal Ecology and Evolution" (1930).

[3] Thorpe, W. H., "Ecology and the Future of Systematics" in "The New Systematics", ed. J. S. Huxley (1940).

[4] Thorpe, W. H., *Brit. J. Psychol.*, **34**, 66 (1944).

[5] Thorpe, W. H., *J. Animal Ecol.*, in the press (1945).

[6] Huxley, J. S., "Evolution: The Modern Synthesis" (1943).

[7] Mayr, E., "Systematics and the Origin of Species" (1942).

[8] Cushing, J. E., Jr., *Condor*, **46**, 265 (1944).

[9] Mather, K., *Biol. Rev.*, **18**, 32 (1943).

Inheritance of Melanism in Grey Squirrels

While shooting grey squirrels on the Duke of Bedford's estate at Woburn this spring, some specimens were obtained which throw light on the inheritance of melanism in this species (*Sciurus carolinensis* Gmelin). So far as can be discovered, there is nothing in the literature about this. Nelson[1] states that in some parts of America litters are found to contain a black young; but there is no information on the proportion of black to grey young, or on the colour of the parents.

A grey male and female were shot in March of this year at Woburn, and a litter of four young taken from the drey which they had been occupying. Of these, one was black. If, as seems likely, the adults shot were the parents, they would appear to have been heterozygotes, carrying the factor for melanism, and it may be assumed that a proportion of the young of the normal grey colour were also heterozygotes; thus melanism in this species seems to be recessive and unifactorial.

Another drey about half a mile away, in the same od, was found to contain a black female suckling single black young one.

Grey squirrels were first introduced into Woburn the late Duke of Bedford in 1890. The black ase was introduced later, but unfortunately ere is no record of the numbers involved, nor the locality from which the introduction was ade.

Melanic grey squirrels have been recorded from tario, the Alleghanies of Pennsylvania, New unswick, Michigan and Minnesota. They are stated occur locally, and to be confined to narrow limits. l these areas are included in the range of one subecies of *Sciurus carolinensis*, namely, *carolinensis ucotis* Gapper. It is possible that the melanism occurs ly in this sub-species; in which case the grey uirrel population of Great Britain includes the *ucotis* form. In Great Britain melanics are found so at Ashwell and Northchurch in Hertfordire[2].

The Continental red squirrel (*Sciurus vulgaris* L.) as a melanic form, which has been noted in large umbers in many parts of its range. Neither case as been analysed genetically.

A degree of variation is found in the melanic forms f both species. Melanic grey squirrels were found ith brown underparts, or with the hairs of the back pped with brown. One specimen had a streak of hite on the belly. The saturation of melanism ppears to be slight enough to be affected by variation f the rest of the gene complex.

Dr. E. B. Ford, of the Department of Zoology and omparative Anatomy, University of Oxford, and Ir. C. Elton, director of this Bureau, kindly gave dvice in this matter. The Duke of Bedford vas asked for details of the introductions into Woburn.

MONICA SHORTEN.

Bureau of Animal Population,
University Museum,
Oxford.

May 1.

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[1] Nelson, E. W., *Nat. Geog. Mag.*, **33**, 371 (1918).

[2] *Trans. Herts Nat. Hist. Soc. Field Club*, **22**, 53.

Heterokaryosis and the Mating-Type Factors in *Neurospora*

EXPERIMENTS on the production of heterokaryosis in *Neurospora* have disclosed a striking difference, in the relationship of mating type to heterokaryosis, between the homothallic species *N. tetrasperma* and the heterothallic species *N. Crassa*.

Hansen and Smith[1] have demonstrated the occurrence of heterokaryosis, that is, the presence of genetically different nuclei within individual cells of a mycelium, in Fungi Imperfecti. More recently this phenomenon has been discovered and investigated in *Neurospora*[2,3,4].

The heterothallic species *N. crassa* and *N. sitophila* each consist of two mating types which are separated at the time of ascospore formation. Single ascospore cultures only produce functional perithecia when brought into contact with cultures of the different mating type. *N. tetrasperma* also possesses two mating types; but in this species, the ascospore is bi-nucleate at its inception, one nucleus containing one of the mating-type or incompatibility factors, the second nucleus containing the opposite factor. A single ascospore culture is therefore heterokaryotic and self-fertile. Homokaryotic lines can be obtained, however, which contain only one or other of the mating-type factors and which do not form functional perithecia unless brought into contact with the different mating-type[5]. Dodge[3] found that, when a certain homokaryotic race of dwarf habit was combined with another race of poor vigour, a heterokaryon was produced showing much greater vegetative vigour than either of the parent races. This occurred whether the second race was of the same or different mating type from the original dwarf.

Beadle and Coonradt[4], working chiefly with mutants of *N. crassa* characterized by their inability to grow well in the absence of certain specific chemical compounds, obtained similar results. When two such deficient mutants were combined, they produced a heterokaryon which was able to grow at the normal rate in the absence of the substances required by the individual lines. There is thus a 'dominance' effect of the normal allele in one nucleus over the mutant allele in the other. These results, however, were obtained only when mutants of the same mating type were combined. Beadle and Coonradt suggest that the absence of this vegetative vigour when mutants of different mating type are combined is due to the tendency of such combinations to form perithecia rather than to grow in a vegetative manner.

Using mutants derived from the fluffy strain of *N. crassa*, I have made many such combinations, using mutants characterized by reduced vigour. In most instances, when the two components belong to the same mating type, a heterokaryon is produced approaching and often equalling the standard fluffy type in vigour. When the mutants are of different mating types, the two mycelia grow side by side or the more vigorous overgrows the other, without any evidence of heterokaryosis whatever. All attempts so far to obtain evidence of heterokaryosis involving nuclei of the two different mating types (which will be described elsewhere) have failed. It is not yet known whether the fusion of hyphæ containing such nuclei is inhibited or whether such fusion occurs but without the two types of nuclei becoming associated.

These results are taken to indicate that the association of nuclei of different mating types occurs at the time of sexual reproduction and not by fusion of vegetative hyphæ.

The difference between a homothallic species such as *N. tetrasperma* and a heterothallic species such as *N. crassa* appears to be that, in the former, nuclei containing the mating-type factors are attracted at all stages in their life-history, whereas in the latter they are repelled or kept apart until the time of sexual reproduction, as suggested by Dodge[6].

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Bionomics of *Hylemyia cinerella* Fallen

A REVIEW of literature reveals that no account has been given on the bionomics of this species in Egypt. It is frequently met with during the spring and autumn; and the average person would be likely to take it for a small house-fly. It is a coprophagous species. It breeds in cow- and buffalo-dung and in human excrement, but the former is much preferred by the fly as a breeding medium. Experiments show that horse manure does not attract the female fly for oviposition. This fly was reared from human fæces by Howard[1]. Other coprophagous species of *Hylemyia* (*H. longicornis* and *H. strigosa*) have been reared from cow- and horse-dung[2].

The breeding season of *H. cinerella* is the spring (March and April) and the autumn (September). On March 4, 1944, three hundred third-stage larvæ were collected from buffalo-dung exposed in the open. These larvæ were transferred to the laboratory and each was placed in a tube with a small quantity of dung and the tube covered with muslin. The larvæ were left to metamorphose and were kept under observation. A few drops of water were added to the dung whenever it showed signs of becoming dry. It was found that the larvæ took three to four days to change to pupæ, and these were transformed to adults in about seven days. The temperature during metamorphosis was about 25° C.

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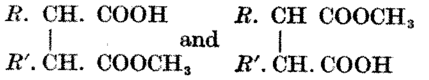
Inhibitory Action of Dialkyl Succinic Acid Derivatives on the Growth *in vitro* of Acid-fast Bacteria

THE elucidation, by Shriner and Adams[1], of the structures of the well-known leprocidal compounds, chaulmoogric and hydnocarpic acids, and the isolation, by Anderson and his co-workers[2], of tuberculostearic and phthioic acids, from the lipoid fraction of tubercle and other acid-fast bacilli, has stimulated synthesis of various branched-chain fatty acids by a number of workers. Of the large number of these acids synthesized by Adams *et al.*[3], the disubstituted acetic acids containing 16–18 carbon atoms were found to be most active against the leprosy bacillus *in vitro*. Adams's most active acid against the tubercle bacillus inhibited the growth of the latter in a dilution of 1/50,000[3]. Robinson and Birch[4] have synthesized a number of trisubstituted acetic acids having two long-chains and have found these acids to possess marked physiological activity resembling that of phthioic acid, producing cell reactions in animals as well as being strongly inhibitory of the growth of the tubercle bacillus *in vitro*.

The late Prof. T. J. Nolan suggested to one of us that roccellic acid, a product isolated from the lichen *Lecanora sordida*, having a branched structure, might be inhibitory of the growth of mycobacteria. This acid is a disubstituted succinic acid having the structure α-methyl-α′-*n*-dodecyl succinic acid[5]. It proved, however, to be only weakly inhibitory *in vitro* against *Myco. phlei* and *Myco. tuberculosis* (*bovis*). This was in agreement with the findings Adams relative to α-butyl-α′-*cyclo*hexyl ethyl succi acid. No significant increase in antibacterial activ was noted by us with other dialkylated succinic acd for example, α-methyl-α′-*n*-hexadecyl, α-α′-di-*n*-hep succinic acids.

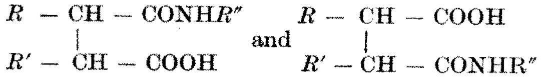
When, however, a methyl alcoholic solution of t anhydride of any of the above acids is neutraliz with dilute alkali, only one equivalent of alkali taken up and the neutral solution contains a mixtu of the isomeric monomethyl esters:



$$\begin{matrix} R.\,\mathrm{CH.\,COOH} \\ | \\ R'.\,\mathrm{CH.\,COOCH_3} \end{matrix} \quad \text{and} \quad \begin{matrix} R.\,\mathrm{CH\,COOCH_3} \\ | \\ R'.\,\mathrm{CH.\,COOH} \end{matrix}$$

A solution prepared in this way inhibits the growth the routine organisms, *Myco. phlei*, *Myco. smegmat* and *Myco. Rabinowitz* at a dilution of 1/20,00 1/40,000 of the monoester for six days (the duratio of the experiment) and *Myco. tuberculosis* (*bovis*) at dilution of 1/200,000–1/400,000 for 6–9 weeks whe certain succinic anhydrides are used. The employ ment of other alcohols in the production of the hal esters has shown that on the whole no improvemen in antibacterial effectiveness may be looked for i that direction.

The cloaking of one of the – COOH groupings wa also effected by preparing mixed monoanilides the type



$$\begin{matrix} R - \mathrm{CH} - \mathrm{CONH}R'' \\ | \\ R' - \mathrm{CH} - \mathrm{COOH} \end{matrix} \quad \text{and} \quad \begin{matrix} R - \mathrm{CH} - \mathrm{COOH} \\ | \\ R' - \mathrm{CH} - \mathrm{CONHR}'' \end{matrix}$$

where $R''\mathrm{NH_2}$ represents a wide variety of amino compounds, such as *p*-aminobenzene sulphonamide *p*-aminobenzoic ester, aniline, 2-aminothiazole, etc The inhibitory action of these compounds is of the same order as that of the half-esters but generally somewhat weaker.

All these active substances are strongly hæmolytic, bringing about the laking of washed human red blood cells in 30 minutes at a dilution of 1/50,000 on the average. Incorporating in the solution one eighth of its volume of human serum reduces the hæmolytic dilution to 1/2,000. Unfortunately, it was found that the antibacterial activity of the solution also was now weakened to a similar extent. Preliminary experiments indicate that the globulin fraction of the serum is responsible for the antagonism. It is generally assumed that an antibacterial substance which is strongly antagonized *in vitro* by serum or a tissue extract will prove ineffective *in vivo*. With a pathogen which grows so slowly as *Myco. tuberculosis*, it may, however, be possible to obtain a concentration of unadsorbed drug sufficient to retard at least the growth of the organism *in vivo*. As investigated so far, these drugs do not appear to be extremely toxic when injected intramuscularly into guinea pigs. Animal protection experiments are now in progress and the results will be published in due course.

Synthesis of other acids is proceeding, but present indications are that the molecular weight of the acid, or alternatively the total number of carbon atoms in the two substituents, must lie within a definite range to produce maximum tuberculocidal activity in the half-ester. Furthermore, with a definite molecular weight, maximum activity is reached when the two substituents are of equal magnitude.

Thus α-ethyl-α′-dodecyl succinic monomethyl ester inhibits *Myco. tuberculosis* (*bovis*) *in vitro* for six eks at 1/400,000, while the isomeric α-α'-di-*n*-heptyl d ester inhibits for three to four weeks at 1/800,000–,000,000 and for six weeks at 1/300,000. The ain used in these experiments was from the National llection of Type Cultures (No. 46) and was grown ordinary nutrient peptone broth.

These drugs inhibit the growth of *Staphylococcus reus* at 1/20,000 and *C. diphtheriæ* (*mitis*) at 40,000 *in vitro*. They do not affect the growth of *ct. Coli* or of *Aerobacter aerogenes* at 1/1,000.

We are indebted for fellowships to the Medical search Council of Ireland, which financed this vestigation.

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'Fissibactericidal' Nature of Penicillin Action

WORK reported in several recent papers[1,2] has erified the bactericidal mode of action of penicillin n certain bacteria. The most important point rought out in these publications is that penicillin orks preferentially, or solely at low concentrations, n those bacteria in the growth phase or undergoing ctual fission.

Just as it was logical for one to search for anti-acterial substances produced by various micro-rganisms grown in the presence of bacteria, it seems logical that some of the moulds or other micro-organisms thus growing and competing with any bacteria present for the available food supply should finally become able to produce and secrete substances which are active in low concentration upon rapidly growing bacteria. The 'invading' bacteria would be of no immediate importance to such micro-organisms unless they were actively growing, since the latter would not have to share with them the food commonly available. This manner of action, which has been proved to exist *in vitro* for *S. aureus*, should it also be present in Nature, would offer a way of survival for the bacterial species in question, since any change in conditions which of itself would arrest active fission of the 'invading' bacteria would render them insusceptible to the antibacterial action of the penicillin-like secretion.

This above discussion must for the present be limited to penicillin, since the process has been proved for this substance only. The concept, however, is thought to be of more general interest and application and is pointed out for this reason.

It is felt that a new word is needed to describe the particular kind of bactericidal action discussed here, and typified by the action of penicillin on susceptible organisms (*S. aureus*). This word must mean an agent which kills bacteria only when they are growing or dividing, and in this sense, the term 'fissibactericide' is tentatively suggested. Since the experimental work to date has eliminated most of the other phases in the growth-cycle as ones during which the organism is most susceptible to the action of penicillin, the stem 'fissi-' has been chosen.

Additional work is being carried out which will extend observations on the *modus operandi* of fissibactericidal substances.

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An Undialysable Pressor Principle in Organ Extracts

IN an earlier[1] communication the occurrence of an adrenaline-like pressor substance in ether extracts of various animal organs has been reported. The primary extracts were made with two volumes of alcohol. After evaporation of the alcohol from the filtrate and removal of fats and lipoids with ether, the clear aqueous phase was subjected to dialysis for forty-eight hours in 'Cellophane' bags against running water. The content in the bags after dialysis showed a strong pressor action on the cat in chloralose anæsthesia. On concentration and treatment with six volumes of alcohol, the pressor activity was found partly in the precipitate and partly in the filtrate. After this treatment the whole of the pressor activity became dialysable.

The two fractions, the alcohol-soluble and the alcohol-insoluble one, showed different properties. The former behaved in many respects like the adrenaline-like substance described earlier[1], whereas the latter was stable in alkali but destroyed by heating in an acid solution.

Purification work and analysis of the biological actions is in progress.

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Losses of Nitrous Nitrogen from Soils on Desiccation

LOSSES of nitrite nitrogen from acid soils have been reported by a number of workers[1]. Recently, during the course of our studies on the losses of nitrogen from soils, we noticed that a part of the nitrous nitrogen disappeared when soils with a *p*H value higher than 7·0 were allowed to dry.

TABLE 1. EFFECT OF DESICCATION ON NITROUS NITROGEN OF THE SOIL.

Serial No.	Treatment of the soil	Mgm. nitrogen per 100 gm. soil		
		Am. 'N'	Nitrous 'N'	Nitric 'N'
1	Control	0·84	0·01	1·6
2	,,	0·84	0·01	1·6
3	With 5 mgm. nitrous 'N'	0·75	1·02	1·6
4	,, ,,	0·75	0·96	1·6

This observation was followed up to discover whether the observed disappearance of nitrous nitrogen took place due to one or the other of the following causes: (1) oxidation of nitrite nitrogen to nitrate; (2) reduction of nitrous nitrogen to ammonia; (3) assimilation of nitrous nitrogen by micro-organisms; (4) decomposition of nitrous nitrogen.

The results of experiments in this connexion showed that the disappearance of nitrous nitrogen was neither due to its oxidation or reduction, nor to its assimilation by micro-organisms, but that it was caused by its decomposition with the evolution of nitrous fumes. A desiccating soil containing 10 mgm. nitrous nitrogen per 100 gm. soil was actually found to smell of nitrogen peroxide.

Further experiments revealed that such losses took place only on desiccation and were not due to thermal decomposition of sodium nitrite.

TABLE 2. LOSSES OF NITROUS NITROGEN FROM SOILS KEPT AT 84° C. IN STOPPERED BOTTLES AND OPEN DISHES.

Serial No.	Treatment	Mgm. 'N' per 100 gm. soil	
		Nitrous 'N' in soil	Loss
1	Stoppered bottle	9·1	0·9
2	,, ,,	9·1	0·9
3	Open dishes	0·9	9·1
4	,, ,,	0·8	9·2

The nature of the soil was found to have a significant effect on such losses.

TABLE 3. LOSSES OF NITROUS NITROGEN ON DESICCATION FROM DIFFERENT SOILS.

Serial No.	Soil	Mgm. nitrous 'N' per 100 gm. soil		
		pH	Nitrous 'N' in soil	Loss
1	Sandy loam	8·7	2·4	7·6
2	,, ,,	8·7	2·6	7·4
3	Clay loam	8·7	1·1	8·9
4	,, ,,	8·7	1·2	8·8
5	Saline soil*	9·5	1·9	8·1
6	,, ,,	9·5	1·9	8·1
7	Alkali soil†	10·1	7·7	2·3
8	,, ,,	10·1	7·7	2·3

* Containing 1·02 per cent water-soluble salts (mostly chlorides, sulphate and carbonate of soda).

† Exchange complex nearly saturated with sodium ion.

Having established that nitrous nitrogen is actually lost from non-acid soils, experiments were conducted to study the reactions responsible for such losses. It was found that carbon dioxide and ammonia of the air, exchangeable hydrogen (which may be present in soils with pH higher than 7·0) and catalytic action of the soil were responsible for bringing about these losses. Of these the catalytic action of the soil seemed to be more important than others.

Detailed results are being published elsewhere.

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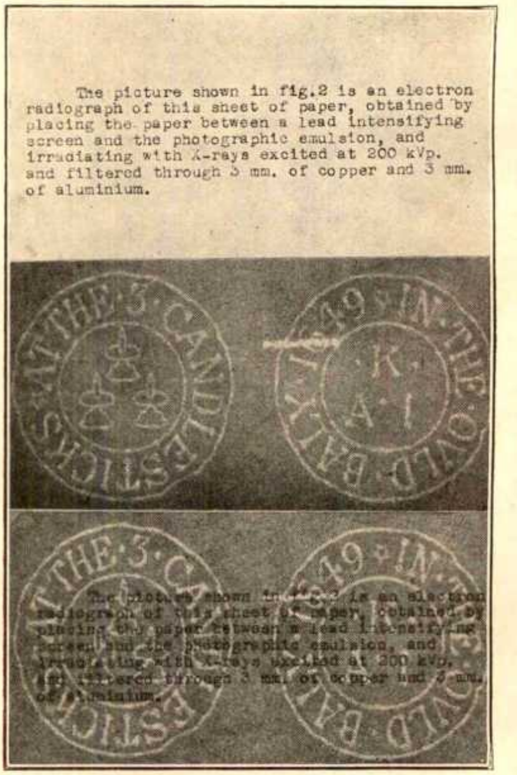
'Electron Radiography' using Seconda β-Radiation from Lead Intensifying Scree

IN order to obtain radiographs of thin, eas penetrated materials, X-rays generated at only few thousand volts (that is, Grenz-rays) have b used. This necessitates the use of a special Grenz- tube having a window transparent to the rays. numerous cases, however, excellent radiographs such materials can be obtained with the appara more commonly available in a radiographic depa ment, by employing the secondary β-radiation emitt under high-voltage X-ray excitation from the le intensifying screens which are frequently used high-voltage radiography.

The best procedure is to place the object to examined between a lead screen and a photograp emulsion in an X-ray cassette, as used in medi or industrial radiography. The lead screen may placed either between the emulsion and the X-r tube or behind the emulsion; but in either case t second lead screen normally used in radiograp should be dispensed with, and the object under exa ination should be in intimate contact with the phot graphic emulsion on one side and the lead screen the other. Single-coated film is preferable to doub coated as the electrons from the lead are almo completely absorbed by the film base and co sequently only affect one emulsion. The seco emulsion, therefore, only serves to increase the f on the film due to the direct action of the X-ray A 'contrasty' type of emulsion has been found



The picture shown in fig.2 is an electron radiograph of this sheet of paper, obtained by placing the paper between a lead intensifying screen and the photographic emulsion, and irradiating with X-rays excited at 200 kVp. and filtered through 3 mm. of copper and 3 mm. of aluminium.

Top: PHOTOGRAPH OF SHEET OF PAPER USING REFLECTED LIGHT SHOWING SURFACE PRINTING.

Middle: 'ELECTRON RADIOGRAPH' OF PAPER SHOWING WATERMARK AND ERASURE WITHOUT INTERFERENCE FROM PRINTING.

Bottom: TRANSMISSION PHOTOGRAPH WITH LIGHT; WATERMARK AND ERASURE PARTLY OBLITERATED BY PRINTING.

give the best results, and process films are particularly uitable. In order to reduce the relative effect of he direct action of the X-rays, it has been found desirable to use as penetrating a primary beam as possible, and hence to use a high kilovoltage across the X-ray tube. 150 kVp. can be employed, but better results are obtained at 200 kVp. and in both cases the softer components of the radiation should be filtered out. It is possible, however, that with very high voltages the improvement in contrast due to reduction in the general X-ray fog may be offset by a reduction in contrast through the increasing energy and decreasing absorption of the secondary β-radiation from the lead.

Suitable materials for radiography by this technique include paper, plastic materials such as cellulose fabrics, nylon, etc., and certain botanical subjects such as tree and plant leaves. The method is particularly sensitive to differences in thickness, and records of paper structure, watermarks, and in some cases erasures, may be obtained from printed paper without interference from the printing since many printing inks give no radiographic image. The technique is illustrated by the accompanying 'electron radiograph' of a piece of paper and comparison photographs using reflected and transmitted light.

In some cases the results may be complicated by the emission of β-rays from the material it is desired to radiograph. This is particularly liable to occur if the material contains elements of high atomic number. In some cases a 'positive' may be obtained instead of a 'negative', due to the β-emission from the material itself more than compensating for its absorption of electrons from the lead screen. In addition, baryta-coated papers may give a poor result on account of a faint but perceptible fluorescence excited in some samples of baryta by X-rays; this tends to fog the emulsion and greatly reduces the contrast of the electron radiograph.

Although the effect has only been studied with lead screens, there is no reason why other metals of high atomic number, such as silver, platinum or gold, should not give a similar result.

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Accuracy of Atomic Co-ordinates Derived from Fourier Synthesis

In a paper, to appear in full elsewhere, I have investigated the accuracy of the atomic co-ordinates obtained from the three-dimensional Fourier syntheses of X-ray crystal structure analysis.

Representing the synthesis in the form:

$$D(x,y,z) = \frac{1}{V} \sum\sum\sum_{-HKL}^{+HKL} \mid F(h,k,l) \mid \cos\left[2\pi\left(h\frac{x}{a} + k\frac{y}{b} + l\frac{z}{c}\right) - \alpha(h,k,l)\right], \quad . \quad (1)$$

and neglecting errors of computation, two sources of inaccuracy occur: (*a*) experimental errors in the $|F|$ values; (*b*) errors due to (H,K,L) being finite.

Information as to the magnitude of the errors in the $|F|$ values has recently become available during a redetermination of the structure of dibenzyl by Jeffrey[1]. This structure was originally examined by Robertson[2], and a comparison of the two sets of experimentally determined $|F|$ values shows that the errors appear to be independent of the magnitude of the structure factors and to have a most probable value:

$$\Delta e = \pm 0{\cdot}6. \quad . \quad . \quad . \quad (2)$$

Examination of the shape of the atomic peaks derived from a number of Fourier syntheses shows that the radial density distribution can be closely represented by the function:

$$d(r) = Ae^{-pr^2} \quad . \quad . \quad . \quad (3)$$

where A depends on the atomic number of the particular atom and p appears to be fairly constant over a number of atoms from carbon to sulphur, a mean value being,

$$p = 4{\cdot}69. \quad . \quad . \quad . \quad (4)$$

A combined analytical-statistical analysis leads to the relation:

$$\varepsilon < 90{\cdot}8\,\Delta e/N\sqrt{V}(\lambda p)^{5/2}, \quad . \quad . \quad (5)$$

where ε is the most probable error in the co-ordinate, N is the atomic number of the particular atom, V is the volume of the unit cell in $A.^3$, and λ is the wave-length corresponding to the smallest spacings observed. Taking the values of Δe and p given in (2) and (4), and considering a carbon atom in a unit cell of volume

$$V = 583\ A.^3, \quad . \quad . \quad . \quad (6)$$

equation (5) leads, when all the information obtainable with copper $K\alpha$ radiation is used, to the value,

$$\varepsilon < 0{\cdot}0027\ A.$$

A formula is also given for the case in which errors are proportional to the order of their parent reflexions.

The problem of finite limits of summation is more complicated. For a simple system containing only two carbon atoms, the errors, calculated as upper limits, where ρ is the radius of the sphere containing the reciprocal points of all planes included in the summation, are:

ρ	ε(A.)
1·5	0·019
1·8	0·009
2·0	0·005

The polyatomic case cannot be given general expression since the atomic positions form a determined system and are not subject to statistical laws. In any *given* structure the errors can, however, be ascertained by the following procedure. Having calculated the structure factors from the final atomic co-ordinates, a synthesis is computed using these *calculated* values as coefficients. Any terms not included in the original synthesis with experimental coefficients are similarly omitted in this new synthesis. The co-ordinates derived will, in general, deviate slightly from those used in calculating the $|F|$ values; these deviations give the errors, with reversed signs, of the original co-ordinates. A trial on an actual structure[3] shows them to have a value of about

$$\varepsilon = \pm 0{\cdot}02\ A. \quad . \quad . \quad . \quad (7)$$

It is suggested that by applying these corrections to derived co-ordinates more accurate values of the latter may be obtained, having errors approximately those of experiment given by equation (5).

Finally, the value of p is related to the quantity B defined by Debye[4] and Waller[5] by means of the equation

$$\frac{1}{p} = a(B + c), \quad . \quad . \quad . \quad (8)$$

where a and c are constants. This relation enables the effect of thermal agitation to be examined.

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A Colour Reaction in Yeast

AFTER being dried at 90° C., bakers' yeast pretreated with sodium fluoride assumes a more or less strong red colour, all according to the pH of the solution in which the yeast has been shaken. On the other hand, untreated yeast assumes a yellow colour after drying. With concentrated hydrochloric acid there is obtained from the red yeast a wine-red extract, which has a pronounced maximum at 4900 A. Fig. 1 shows the absorption spectrum of the extract in half concentrated hydrochloric acid.

After drying at 90° untreated yeast also gives a red extract with hydrochloric acid with the same absorption spectrum as is shown in Fig. 1. The intensity of the colour is, however, weaker.

Quantitative photometric determinations were carried out with solutions obtained by the drying and extraction of untreated yeast and also yeast pretreated with sodium fluoride at different pH's. The colour of the dried yeast was found to run parallel with the intensity of the colour of the extract. The maximal colour intensity was reached after a pretreatment of the yeast with sodium fluoride at pH 4.

Yeast dried over phosphorus pentoxide at room temperature gives a violet extract with hydrochloric acid. In this case, too, the same difference between untreated yeast and yeast treated with sodium fluoride was noticed. But the colour of the dried, treated yeast differs very little from the yellow colour of the untreated yeast. To get a red yeast, as to get a red extract, it is necessary to heat to 90°.

Further, fresh yeast gives a violet-coloured extract with hydrochloric acid without drying. In this case, too, treatment of the yeast with sodium fluoride increases the intensity of colour.

Quantitative photometric determinations were made with solutions which were obtained after the extraction of, on one hand, fresh untreated yeast, and, on the other, with yeast treated with sodium fluoride at different pH's. Maximal colour intensity was reached after treatment at pH 5. Fig. 2 shows the dependence on pH of the colour intensity of the violet and red solutions respectively, the former measured with filter S 52, the latter with S 50, of the Pulfrich Stufenphotometer.

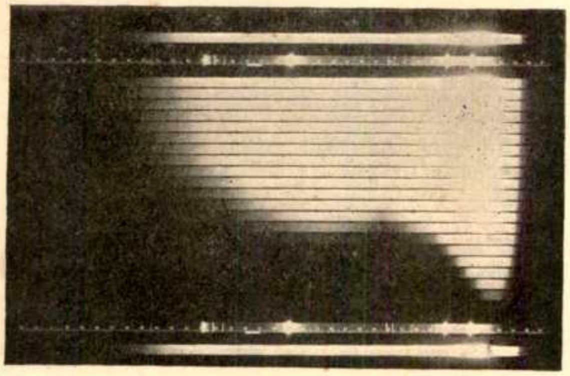

Fig. 1.

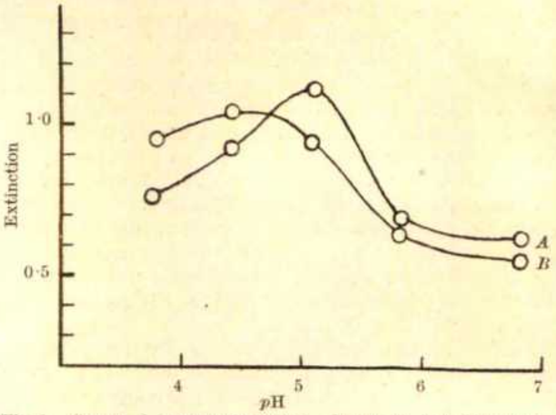

Fig. 2. CURVE A, VIOLET SOLUTION. CURVE B, RED SOLUTION.

When concentrated hydrochloric acid is added to bakers' yeast dried at room temperature, a violet extract with the same absorption maximum as the violet solution from fresh yeast is also obtained. After the dried yeast has been shaken in water for several hours, the colour intensity of the extract is reduced by subsequent treatment with hydrochloric acid. The cause may be either a washing-out of the colour-giving substance from the cell, or its partial transformation to a non-colour-producing substance. To discover the cause the washing-water will be examined.

Attempts to identify the red and violet colouring-matters formed were chiefly made spectrophotometrically, since attempts to isolate them have not hitherto been successful. With great probability they are condensation products between compounds containing an indole nucleus (tryptophane, skatole, indole) and aldehyde or ketone derivatives in the presence of a strong acid. The absorption spectra of such dye-stuffs have been examined by Bardachzi[1]. He observed that the spectrum could be broken up partly by heat-treatment, partly by the choice of indole nucleus source (pure tryptophane or proteins), and he assumed this to be due to the manner of binding of the tryptophane in proteins and their higher breakdown products. There is good agreement between his curves and mine. That the spectrum is broken 200 A. to the short-wave side in the case of the red extract in comparison with the violet one can thus be explained by Bardachzi's assumption.

In this reaction between tryptophane or its derivatives and carbohydrates in hydrochloric acid solution Jordan and Pryde[2] found a sensitive method of separating fructose from aldohexoses. Ketohexoses react at 40° in the course of 15 minutes, aldohexoses only at 80° in the same time. That fructose reacts specially sensitively is also known from other reactions, as in the Pettenkofer's reaction[3], and in the reaction between carbohydrates and phenols[4]. As I found, at 40°, the hydrochloric acid extract from yeast pretreated with sodium fluoride reaches full colour intensity in five minutes, that from untreated yeast, on the other hand, only reaches a weak colour

40° in 15 minutes, and a full colour intensity only 80° in the same time. Probably the promoting fect of sodium fluoride on the colour intensity is ue to accumulation of ketose in the yeast. Accord-g to the findings of Jordan and Pryde, it is more kely a question of a hexosemonophosphoric or hexosephosphoric acid accumulation than that of a riose.

In the case of yeast dried at room temperature, the rying process seems to play a similar part to the ddition of sodium fluoride.

Experiments seem to show that in the case of etoses the condensation with tryptophane commences at 90°, without the presence of a strong acid. herefore in the case of red dried yeast, too, the ssumption of ketose accumulation is a very probable xplanation.

That the carbohydrate metabolism is disturbed y sodium fluoride is well known. In the presence of dded substrate there is an accumulation of phosphoglyceric acid[5,6,7]. Without added substrate—as n my experiments—there is an accumulation of hexose monophosphoric acid in dried brewer's yeast[5], hexose diphosphoric acid in dried plasmolysed baker's yeast[8]. There seem to be no reports of possible accumulation products in the absence of added substrate in fresh bakers' yeast, for which reason the above-mentioned observations might afford an insight into related problems. On the basis of the observations of Jordan and Pryde, a sensitive colour-reaction for ketoses could be developed with the yeast substances as reagents. The quantitative determinations which have been made indicate that such a method would render it possible to follow, in a simple manner, even small variations in the quantity of ketoses in the yeast under varying conditions.

MIGNON MALM.

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Experimental Biology,
University of Stockholm.
April 4.

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[1] Bardachzi, F., *Hoppe-Seylers Z.*, **48**, 145 (1906).

[2] Jordan, O., and Pryde, J., *Biochem. J.*, **32**, 279 (1938).

[3] Ohyama, Y., *J. Biochem.*, **27**, 351 (1938).

[4] Karaoglanov, Z., *Z. analyt. Chem.*, **121**, 92 (1941).

[5] Nilsson, R., *Sv. Vet. Ak. Ark. Kemi, Mineral. och Geol.*, A, **10**, No. 7 (1930).

[6] Neuberg, C., and Kobel, M., *Biochem. Z.*, **263**, 221; **264**, 456 (1933).

[7] Meyerhof, O., and Kiessling, W., *Biochem. Z.*, **267**, 331 (1933).

[8] Myrbäck, K., and Ortenblad, B., *Biochem. Z.*, **292**, 230 (1937).

Halogenation in the Allyl Position

WE should like to make a few comments on the recent communication by W. A. Waters[1] in criticism of F. S. Spring[2] for stating that substitution in the allyl position of olefines is a new reaction attributable to Ziegler and his collaborators[3].

Although the reactions of halogen-containing substances with olefines to effect halo-substitution on allyl carbon atoms are of great interest, it seems to us that the most important reaction of allylic substitution is the *direct* halogenation of olefines at elevated temperatures discovered by Groll and others[4] in these Laboratories. Thus, for example, at temperatures of the order of 400° C., by an apparently homogeneous reaction, almost all the halogen in a 1 : 7 mixture of chlorine and propylene reacts readily by substitution to form allyl chloride. Bromine behaves similarly.

Waters conveys the impression that Farmer and his colleagues[5] were the first to show that the substitution into olefines in the α-methylene position was a reaction involving free radicals. In the reference to Farmer, cited by Waters, that author himself attributes the interpretation of the mechanisms of high temperature substitutive halogenation of olefines to two of the authors of this letter. It has been shown[6] that both addition and substitution occur under the experimental conditions principally, although not exclusively, by radical chain mechanisms, and that substitution is the dominant reaction at higher temperatures. Catalysis of the chain processes was achieved by the use of small amounts of tetra-ethyl lead, and, while under some conditions oxygen was a powerful suppressant of both reactions, under others a trace of oxygen acted as a powerful catalyst for the substitutive chlorination of propylene to form allyl chloride at temperatures as low as 272° C. In this connexion it may be mentioned that Ingold[7] states that peroxide catalysis (and hence by analogy oxygen catalysis) of a reaction is "compelling" evidence for a free radical mechanism. Such evidence is also accepted by Waters[8] as "conclusively" proving that such a process occurs. Of course, there is a wealth of experimental evidence for both acceleration and inhibition of radical reactions, from which may be cited Kharasch's oxygen- and peroxide-catalysed 'abnormal' addition of hydrogen bromide to unsymmetric olefines[9] and the quantitative photochemical 'anti-Markownikov' reaction involving such olefines and either hydrogen bromide or hydrogen sulphide[10].

As have others in the past[11], we wish to emphasize that the postulation[12] of free hydrogen atoms, produced by attack of organic radicals on molecules, as chain-carrying species in reactions is precarious, as the energetics of such reactions are generally entirely unfavourable.

WILLIAM E. VAUGHAN.
FREDERICK F. RUST.
GEORGE W. HEARNE.

Laboratories of
Shell Development Company,
Emeryville, California.
March 3.

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[1] *Nature*, **154**, 772 (1944).

[2] Annual Reports of the Chemical Society, **40**, 101 (1943).

[3] *Annalen der Chemie*, **551**, 80 (1942).

[4] Groll and Hearne, *Ind. Eng. Chem.*, **31**, 1530 (1939). Engs and Redmond, U.S. Patent 2,077,382, April 20, 1937. Groll, Hearne, Burgin and LaFrance, U.S. Patent 2,130,084, September 13, 1938.

[5] *Trans. Faraday Soc.*, **38**, 340 (1942).

[6] *J. Org. Chem.*, **5**, 472 (1940).

[7] *Trans. Faraday Soc.*, **37**, 791 (1941).

[8] *Trans. Faraday Soc.*, **37**, 792 (1941).

[9] See Mayo and Walling, *Chem. Rev.*, **27**, 351 (1940).

[10] Vaughan and Rust, *J. Org. Chem.*, **7**, 472, 477 (1942).

[11] See, for example, ref. (9), (p. 358); also, Weiss, *Trans. Faraday Soc.*, **37**, 793 (1941).

[12] For example, see references (5) and (8).

As Spring noted in his report, due credit must be given to the chemists of the Shell Development Company of California for their original success in effecting the vapour-phase halogenation of olefines in the allyl position. While their evidence for the atomic mechanism of this process might have received mention, there can now be few chemists who would picture a homogeneous gas reaction of this type as anything other than a free radical process.

The mechanism of chlorine substitution in solution is, however, less well established, and in the past the N-halogeno imides, such as Ziegler's reagents, have often been represented as yielding either halogen cations (*a*), or molecular halogens (*b*) and not free halogen atoms (*c*):

(*a*) $R_2\text{N–Cl} \rightleftharpoons R_2\text{N}^- + \text{Cl}^+$ (unimolecular ionic reaction).

(*b*) $R_2\text{N–Cl} + \text{HCl} \rightleftharpoons R_2\text{N–H} + \text{Cl}_2$ (bimolecular reaction)

(*c*) $R_2\text{N–Cl} \rightleftharpoons R_2\text{N}\cdot + \cdot\text{Cl}$ (free radical reaction).

The prime reason for my comment in *Nature* of December 16, 1944, was to direct attention to this evidence for reaction by mechanism (*c*), in view of its theoretical significance in relation to the possible modes of covalent bond fission in solution, rather than to claim priority for proposing a mechanism for chlorination of olefines in the allyl position.

In establishing criteria for recognizing free radical reactions in solution, analogies with gas reactions are particularly valuable, though in commenting briefly on a particular reaction it is impossible to do more than cite recent relevant reviews (for example, my references 5 and 8).

W. A. WATERS.

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April 29.

Operators in Quantum Theory

IN his article on "Causality or Indeterminism?" in *Nature* of March 10, Prof. H. T. H. Piaggio refers to the restriction on quantum mechanical operators made by the condition that they be hypermaximal, and suggests that this conceals important requirements. In fact, the literature on the subject does not discuss the physical meaning of this requirement. Dirac, in his "Principles of Quantum Mechanics", substitutes the condition that "only those Hermitian operators that satisfy the expansion theorem represent observables": this is mathematically equivalent to hypermaximality, but also has no clear physical meaning.

The condition that an operator be Hermitian has the simple basis that the corresponding observable must have real values. It seems worth while to inquire what physical requirement on the operators can replace the above conditions. Now it can be shown that those, and only those, Hermitian operators are hypermaximal for which the corresponding Schrodinger equation

$$H\ \psi(t) = \frac{1}{i}\,\frac{d\psi}{dt}, \qquad . \quad . \quad . \quad . \quad (1)$$

with the initial condition $\psi(0) = \varphi$ has a solution for all positive and negative t and for every wave-function φ lying in the domain of the operator, H.

If, for example, we take the momentum operator for a line infinite in both directions—the operator $\frac{1}{i}\frac{d}{dx}$ operating on wave functions $\varphi(x)$ with

$$\int_{-\infty}^{\infty} |\ \varphi\ (x)\ |^2\, dx = 1,$$

then the equation (1) with the initial condition $\psi(x,0) = \varphi(x)$, has the solution $\psi(x,t) = \varphi(x+t)$ for all values of t.

If, on the other hand, we consider a half-infinite line, from 0 to ∞, the wave-function is $\varphi(x)$ with $0 \leqslant x < \infty$. As is easily seen, the operator $\frac{1}{i}\frac{d}{dx}$ operating on wave-functions in this half-infinite lin is Hermitian if, and only if, its domain is confine to wave-functions with $\varphi(0) = 0$. The equation (1 with initial conditions $\psi(x,0) = \varphi(x)$, has the solutio $\psi(x,t) = \varphi(x + t)$ for all negative t, where we tak $\varphi(x) = 0$ if $x < 0$; but for $t > 0$ the solution i formally $\varphi(x+t)$, which does not lie in the domain o the operator if $\varphi(t)$ is not zero. Hence the equation does not have a solution for all positive t. Thi corresponds to the obvious fact that a particle cannot move in a half-infinite strip with constan momentum for an infinitely long past and future.

The examples illustrate what happens in the genera case; since the equation (1) is the equation of a system for which the probability that the observabl corresponding to the operator H should have a give value, or should have a value lying in a given interva is constant, we can restate the condition in th following form:

A Hermitian operator is hypermaximal if, and only if, it is possible for a physical system to maintain a constant probability distribution of the observable corresponding to the operator for a time infinite i both directions.

This condition makes it fairly obvious why only hypermaximal operators obey the expansion theorem For that theorem to hold, the system must be capable of stationary states, that is, of states in which the probability distribution of the values of the observable is constant from $t = -\infty$ to $t = \infty$.

This approach to operator theory seems to link it more closely with the physical theory than does the theory of von Neumann and Stone. In a paper to appear in the *Quarterly Journal of Mathematics*, I have shown that it leads to a proof of the spectral theorem rather simpler than those of von Neumann and Stone, and also have proved the equivalence of the condition stated with hypermaximality.

J. L. B. COOPER.

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April 10.

Reform of the Patent Law in Britain

THE article on "Reform of the Patent Law in Britain"[1] criticizes my proposals for patent reform on the grounds that they would reduce the profitability of inventions to financial backers. I would maintain that my proposals would in general have no such effect. I have recommended that the Government should pay patentees rewards in proportion to the economic advantage arising from the application of their patents. Hence the wider these applications (be it by competitors of the patentees or by others) the higher the gains accruing to patentees. It is in fact an essential point of the proposed reform that it would not on the whole take away any of the financial stimulus for the exploitation of patents while leaving everyone free to use them. Even though a closer analysis might reveal cases in which the present form of patents would be somewhat more lucrative to patentees, these cases could be balanced by others in which the reverse would hold.

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[1] *Nature*, 155, 612 (1945).

THE point raised by Prof. Polanyi appears to be ased on a difference of opinion between him and he financial backers of inventors. He is of opinion hat the proposed reform "would not on the whole ake away any of the financial stimulus for the exploitation of patents while leaving everyone free to se them". On the other hand, however, the opinion f the financial backers, insofar as it has been ndicated during recent discussions of suggestions for he compulsory licensing of all patents, is that the nonopoly or *exclusive* licence obtained through the rant of a patent is generally necessary before the nancial arrangements for commercial exploitation f an invention become practicable. The small umber of patents that are voluntarily endorsed icences of right' under the existing arrangements hows that the opinion of inventors is, as a rule, in greement with that of their financial backers.

THE WRITER OF THE ARTICLE.

Strength of Glass and Duration of Stressing

IN the columns of *Nature* recently and in other laces there have appeared various discussions of the elation between the strength of glass and the duration of the stressing, frequently centring on the xperimental results of Mr. T. C. Baker reported in ny paper on the "Mechanical Properties of Glass"[1] n the form of a graph. There, breaking stress is plotted as ordinate against the logarithm of the time as abscissa. This is the way the scanty earlier results were plotted by other investigators.

To save the time of those who have been trying to fit equations to this curve, I may point out that if *reciprocal* of stress is plotted against logarithm of time a perfect straight line is obtained, for the glass specimen, the equation of which is

$$f \times \log_{10}(t/6) = 65{,}000,$$

where f is breaking stress in lb./in.^{2} and t is duration of steady load in microseconds.

If this curve can be extrapolated substantially the implications would be (*a*) at the long time end, the stress that can be supported for an infinitely long time is zero; (*b*) at the short time end, no finite stress can break these specimens if the duration is less than 6 microseconds.

The curve for porcelain rods shown in the same paper also reduces to a perfect straight line so far as the first five experimental points are concerned. The sixth point falls off the line, but the point was obtained by different apparatus in difficult circumstances and may perhaps be distinctly in error.

The physical meaning of implication (*b*), that glass and porcelain rods can stand an infinite load for a finite (but very short) time, is not at present clear. Perhaps the curve cannot be extrapolated too far that way, or perhaps the finite velocity of sound, or of crack propagation, comes in.

The outbreak of the War in the midst of Mr. Baker's researches, and other handicaps, have prevented any full account to the scientific Press of his work: the brief report in 1942 in my own paper above cited has caused much speculation, and Mr. Baker and I hope it may be possible to remedy the omission in the foreseeable future.

F. W. PRESTON.

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[1] *J. Appl. Phys.*, 13, 623 (1942).

Avoidance of Obstacles by Bats

I HAVE read with great interest Mr. Pike's article on bats[1] and Squadron Leader A. K. McIntyre's letter[2] commenting on it. As the latter correctly states, it was Galambos and Griffin who were largely instrumental in proving that bats employ a supersonic form of acoustic 'radiolocation' when flying at night. They were not, however, the originators of this hypothesis, as they themselves state in their papers. This hypothesis was advanced by me as the result of a number of experiments performed in a set of rooms in King's College, Cambridge, the windows of which looked out on to the Cam. During the summer months, bats flew into these rooms in large numbers in the late evening and would remain there until dawn, flying round and round at will. They were unwitting collaborators in my experiments and continued to visit me without fear until the end of the long vacation. As a result of these visits I wrote an article in which I advanced the hypothesis that bats detect and avoid obstacles by hearing reflexions of high-pitched vocal sounds emitted during flight.[3]

This hypothesis has been substantiated in the three interesting papers by Galambos and Griffin.

The main problems of the flight of the bat apparently being solved, there are a number of minor ones to which attention may usefully be directed. I hope to deal with these later.

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[1] *Nature*, 155, 122 (1945).
[2] *Nature*, 155, 672 (1945).
[3] *J. Physiol.*, 54, 54 (1920).

Archæological Exploration in South Africa

ON page 676 of *Nature* of June 2, 1945, reference is made to the South African laws which control the investigation of archæological sites and the collection and exportation of vertebrate fossils.

Control of archæological sites will meet with wide approval because their number is necessarily limited, and the evidence they can give is largely destroyed by excavation. But vertebrate fossils are in an entirely different position. The very important fossil faunas of the Karroo occur irregularly distributed over an area of some 100,000 square miles, a very considerable proportion of which is free from vegetation. They are, of course, not restricted to the surface, so that new specimens are constantly exposed by denudation. The total number exposed at this moment is certainly enormous, and it is certain that no conceivable amount of collecting can exhaust the field or even keep up with the exposure of new specimens.

A comparable case is that of the White River Bad Lands of South Dakota, where an area of some 2,000 square miles has been exploited for some fifty years by from one to a dozen parties each year and still yields enough to satisfy each visitor.

In fact, while the archæological restrictions are imposed for the protection of the evidence, that on fossil vertebrates is for the protection of the South African palæontologists, who do not appear to wish their colleagues to examine the new materials.

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SCIENCE AND EDUCATION

THE Leeds Branch of the Association of Scientific Workers organized a highly successful and well-attended conference on "Science and Education" in the Philosophical Hall of the Leeds City Museum on the afternoon of June 9. Dr. W. T. Astbury was in the chair, and the opening address on "The Educational Policy of the Association of Scientific Workers" was given by Sir Robert Watson-Watt, immediate past president.

Sir Robert said that the only valid objective of a political system is a fuller life for each individual citizen, and that such intermediate objectives as a flourishing export market are merely means to that main objective. Since the export market is necessary to the fuller life, we want, in its interests as well as for other reasons, more technicians, more technology, more scientific workers and more science. But our greatest real need is for more culture, and he hoped that there will be no self-consciousness or shamefacedness in our campaign for culture as the greatest human necessity. It is perhaps fortunate, but only incidental, that more culture is essential to the attaining of more and better science and technology, and thus to a better export market.

To get better men of science their education must be changed, and it cannot be changed sufficiently without changing the education of every pupil and student in the country. In the education of the man of science we must include more principles and fewer facts, since the available facts are now tending to crowd the principles out of our courses. In the education of every student we must include more science and not less of the humanities. The disease which has ravaged our modern world is a disease of malnutrition. Diseases of malnutrition contain two major factors, defects of intake and defects of assimilation. The world's intake of scientific facts and technical products is not, as is sometimes foolishly suggested, excessive; but the intake has grossly outrun our assimilative activity, our appreciation of the inter-relation of the facts and our ability to apply the products beneficently. How can we improve assimilation? Sir Robert said he had been profoundly shocked to hear the Minister for Education in the late Government—a highly successful and progressive Minister for Education—tell a university audience that he "had not much use for mathematics and science" and that "the essential element in our education must continue to be the classics, because the classics tell us how people behave and how they will always behave". A very little store of the humanities of mathematics and science would have safeguarded Mr. Butler from this vicious extrapolation. Even if it had failed in that, it would have carried him to the natural conclusion of his thought process, which is that if people go on behaving as they have been doing, they will deprive themselves of any opportunity of behaving at all.

We must change our education: but where to begin, with the Minister or with the infant pupil? The former is an unpromising and laborious undertaking; the latter is a promising but slow-maturing one, which we must begin now. The quickest result will come from educating our educators, and that can only be done in the one place where true education can be given to true educators, the university.

Sir Robert then summarized briefly the salient points in the policy for education published by the Association of Scientific Workers: For the university, full access for all who can show a reasonable prospe of benefit, a doubled intake overall, a trebled intal for science, a trebled staff overall, capital expenditu of thirty million pounds in the next ten years, annu expenditure rising to the order of fifteen millio within five years, a national academic counci planned facilities for special schools avoiding alik complete monopoly and over-dispersal of the speci facilities. For the national institutes of technology which must be strengthened and extended to com parability with the best American models, integratio into the university structure without confusing th frontiers between the basic sciences and the highe technologies. For the technical colleges, an upwar levelling of status and facilities, and regional associa tion around the regional university as an intellectua and educational focus. For the young peoples colleges, a very great measure of autonomy to th student body, of self-government by the student fo the student. For the part-time student, in th sixteen to eighteen age-group, half of the forty-fou hour week devoted to daytime—and largely whol day—education, principally the education of the social conscience. For the post-primary pupil, leaving age of 15+ as a most urgent interim measure of 16+ at the earliest practicable epoch, an standardization at 16+ to facilitate uniformity o entry levels in the higher institutions. For the primary pupil, absorption of the common bases o scientific method through the pupils' own activity under the guidance of teachers who have themselves learned those bases for themselves. At all stages an intimate co-partnership with industry by the direct participation of those engaged in industry as members of council, as lecturers and as researchers.

Mr. H. Benfield, president of the Leeds Teachers Association, spoke on "The Place of Science in Primary Schools". Emphasizing the importance of basing education on the pupil's own activity and experience, on the encouragement of curiosity, the spirit of inquiry and wonder, he urged that nature study is the best initial approach to science, with progress from the collection of wild flowers through the primary school garden (left as nearly natural as possible) to the study of animals. The aquarium is a valuable means of overcoming urban limitations on this range of subjects. The pupil should learn to observe accurately, to record systematically—in pictorial form at first—and should not be launched in the primary stage on the formal study of a branch of science or of any organized science in detail.

Mr. E. J. Rose, Science Masters' Association, spoke on "The Teaching of Science in Secondary Schools", dealing with the age-group 12–16, with an advanced 50 per cent in the 16–18 group in present circumstances. Quoting the threefold justification for the place of science in a course the main aim of which is to provide an environment for the fullest development of the individual personality, the utilitarian or vocational, the disciplinary and the cultural, he said that while we stand high in literary and artistic performance, the highest glory of Western civilization is in its science. It is this glory, the glory of inquiry, which has to be revealed in the pupil's mind. Interpreting the syllabus for general science prepared by the Science Masters' Association, he re-emphasized the need for making full and continuous use of the pupil's own inventive capacity, the importance of the sentiment which grows up around any subject in the pupil's mind, the importance of adequate emonstration work, but not at the expense of ractical work by the student himself. He showed e need for improved facilities, for laboratory ssistants, for equipment of the kind now plentiful n Service training (episcopes, epidiascopes, projectors nd so on), for laboratories larger and more numerous han those of the present paper plans. Finally, he alled for direct contact between the science teacher and the worker on the frontiers of science, so that the eacher might absorb and re-transmit the spirit of cience.

Mr. J. Maddison, chairman of the Leeds Scientific Film Society, discussed "Teaching by means of the Scientific Film". He too stressed the practical problems of the film in education, the need for ample supplies of projectors and of copies of films, on a scale never yet reached in Great Britain. State production and use in war-time of instructional and informational films has shown the solution of these problems, by giving direct experience on a large scale in the economical making and utilization of such films, always a somewhat expensive business. That there are only 2,000 projectors, many unsuitable and many unserviceable, in British schools now is in part due to the apathy of teachers; that suitable films are scarce is due to the fact that there is no money in making educational films; the pre-war distribution of such films, costing £2,000 to make and £6–£7 per copy, was largely an aid to the sale of projectors.

The film must be a normal tool of teaching technique, and not a 'stunt' irruption into the classroom. It can be used as an incidental illustration to the lesson, as the central feature of the lesson, with other illustrative material grouped around it, or as an invaluable aid in the difficult task of keeping revision alive. The wider purposes of broadening the pupil's outlook, and awakening him to the excitement and drama of scientific outlook is better served by the use of the film in the main school hall, outside the classroom. The inadequate use of the film in adult education is largely governed by the economic factors common to juvenile and adult classrooms, but the commercial film theatre has its place in conveying the spirit and drama of science through the feature film, of which some dealing with continental scientific workers have been very good, though one dealing with a great English man of science was not a success. We need more projectors, more films, more skilled use and more research on the relation of the film to the learning process.

Prof. S. Brodetsky, ex-president of the Association of University Teachers, spoke on "Science and the University". He pointed out the close identity of the policies enunciated by the Association of University Teachers and the Association of Scientific Workers in relation to science and the universities, and suggested that closer co-operation based on this identity of view would be productive. He does not, however, believe that science in the university can stop short of the application stage; "Almost every branch of human activity is a branch of applied mathematics, if you look at it in the right way"; science produces the performance which is based on that application, and education in science cannot therefore be limited to principles. He commented on the relative failure to use the universities fully in the war effort; he regards the present tendency for "the Government to have its own private scientists" as an undesirable one.

There is a growing conviction that the university course is far too restricted and degrees far too specialized. A four-year course, apart from the specialized work, is desirable, and should be directed towards understanding of the safe and cultured life, the development of human thought, with application to the principles of government, economics, medical methods and so on. The thinker, the poet, the man of science, the politician, must not be separated and compartmented; they should learn together that there is no such thing as a branch of learning which is not exciting, fascinating and thrilling.

Dr. P. D. Ritchie, of the Association of Teachers in Technical Institutes, dealt with "Part-Time Technical Education". In the qualifications which the part-time student should bring to part-time education, he puts "a near mastery of written and spoken English" first, ability to transfer thought to symbolism second, ability to transfer to another language third, and knowledge of scientific method only fourth. He believes that we should aim at higher institutes equal to or better than the Massachusetts Institute of Technology and the Zurich Polytechnic, and that the great range of unrelated *ad hoc* courses offered at the technical college level should be brought to a closer relationship leading to a recognized label such as an external B.Tech. degree.

Prof. J. B. Speakman, head of the Textile Department of the University of Leeds, thinks that "The Education of the Technologist" must be carried out in an atmosphere of research, and thus essentially in the university and nowhere but in the university. Part-time education, he said, is a barbaric survival from the industrial revolution. The industries get their leaders largely from the elementary schools, and these leaders have never had contact with the research method which can transform crafts into applied sciences distinguished in their own right. Technological education must provide the men who would understand this process and would become the business men of the future.

Mr. C. V. Bellamy, member of the local executive of the Workers' Educational Association, spoke of the obstacles to success in the proper placing of "Science in Adult Education". The average worker fears science and is nervous of his own ability to tackle anything so complex; there is a shortage of competent tutors—"not every university lecturer or schoolmaster is successful with classes of people tired after a day's work"—and facilities are inadequate, equipment being frequently limited to that which can be borrowed and carried by the tutor himself.

Mr. C. B. Bradley, from a long experience in the administration of education, emphasized the importance of a realization—not always achieved—by members of local authorities that their responsibility to the pupil must take precedence over their responsibility to the ratepayer. "The scene of the struggle for educational progress has now shifted from Parliament to your own Local Authority." The school building of 1870–75, very frequently still in use, is deplorably unsuitable; in buildings and equipment alike it is impossible to exaggerate the bad conditions that prevail in hundreds of elementary schools still in being in all parts of Britain.

The Leeds Branch of the Association of Scientific Workers hopes that in a month or two it may hold a second conference, which will discuss the specific action that should be based on the very comprehensive and stimulating survey of the whole field which was achieved in this first conference.

ROBERT WATSON-WATT.

ESTIMATION OF MULTIPLE CORRELATION BY MEANS OF STEREOGRAPHIC PROJECTION

By G. F. K. NAYLOR

IN practice, the industrial psychologist is frequently faced with the situation in which he has to choose, from a trial test battery of say ten or more tests, those which will prove most effective in the selection of personnel according to some given criterion. He must then seek for answers to the following questions: (*a*) What is the individual validity of each test as judged by the criterion? (*b*) What combination of tests will give the best basis for prediction according to the criterion? (*c*) What will be the predictive value of such a combination? (*d*) How few tests may be used to obtain a validity coefficient the value of which does not depart appreciably from the theoretically best figure? (*e*) In what simple proportions must the scores of the chosen tests be weighted to obtain a close approximation to the best value of the joint validity coefficient?

The answer to (*a*) is obtainable only by direct correlation procedure, while those to (*b*), (*c*), (*d*) and (*e*) are normally reached after algebraic and arithmetical computations based upon the results of (*a*) and the inter-correlations between tests.

The recognized procedure is that of partial regression and multiple correlation, as developed by Udny Yule and Karl Pearson. Pearson in particular directed attention to the fact that the formulæ developed by him for dealing with statistical selection (of which, as has recently been shown, partial correlation is merely a special case) can readily be interpreted in terms of spherical trigonometry, and printed a graph for dealing with the simplest cases of all[1]. To avoid and illustrate the somewhat elaborate algebraic manipulations which multiple correlation involves, several other observers have used or suggested a graphical procedure. Kelley has proposed a simple 'alignment chart'[2]; for analogous problems in factor analysis Garnett has proposed to take cosines of angular distances to measure correlations (the basis of Thurstone's 'graphical rotation'); Burt has used the same principle with spherical trigonometry, using a 'globular' projection to obtain a two-dimensional representation[3].

All these methods, however, are admittedly somewhat cumbersome: Pearson's full procedure, for example, required the use of a spherical trigonometer; and none has come into general use for practical purposes. Accordingly it is suggested that the following procedure will be found of great practical use. The chief novelties are (i) the use of a stereographic projection, and (ii) the combination of a graphical procedure with certain approximate equivalences similar to those used by Kelley in building up his multiple correlations. The method has already been used in selecting psychological test batteries of the ordinary type, and found sufficiently reliable for most practical purposes.

As with most other graphical methods, the underlying assumption is that the related variables can be represented by axes in space inclined to one another at angles the cosines of which are the respective correlation coefficients. On this basis three such variables may be represented as the angular points of a spherical triangle *ABC* (the points where such directions emerge from the sphere the centre of which is the point of radiation). The sides of the triangl *a*, *b*, and *c*, represent the primary correlations r_B r_{CA} and r_{AB} respectively, while its angles *A*, *B* and represent the partial correlations $r_{BC.A}$, $r_{CA.B}$ an $r_{AB.C}$, using the usual notation. It can then b shown that the perpendiculars from the vertices t the opposite sides represent the multiple correlation $R_{A(BC)}$, $R_{C(AB)}$ and $R_{B(CA)}$; and the points whe these perpendiculars meet the opposite sides indicat the combination of each pair of variables whic correlates best with the remaining one. The weighting of standard scores for each pair of variables to produce the best correlation with the remaining one i in inverse proportion to the cosines of the angles a the points represented by the tests themselves, that is

$$\frac{\text{Weighting } A}{\text{Weighting } B} = \frac{\cos B}{\cos A}.$$

With the aid of a stereographic net, it is possible to cope with the three-dimensional problem on two dimensional paper. The stereographic net as used in mineralogy or cartography is simply one of many devices which enables all points on the surface of a sphere to be represented on one plane, so that the angular distances between them may be read off directly in terms of any appropriate angular function; in this case the appropriate function is the cosine rather than the angle itself, and a net graduated in cosines is used in place of one graduated in degrees

The method suggested below for estimating multiple correlations for *more* than two tests and a criterion differs from the more accurate but lengthier algebraic one, in that combinations of tests are built up successively instead of simultaneously. However, if care be taken to begin with the pair of tests which correlate best with the criterion (and, so far as is practicable, least with one another) the degree of error introduced in the succeeding steps appears to be in practice quite small in the case of ordinary aptitude test batteries. Moreover, the observed graphical result is slightly *less* than the possible maximum, so the estimate is conservative and safe to use; for example, in an example quoted by Holzinger[4], concerning relation of Beta tests to Stanford Binet as a criterion, the stereographic method indicates that a multiple correlation coefficient of 0·72 could be obtained by the use of Tests 4, 7 and 3, whereas the computed value for the whole battery is given as 0·731. Garrett[5] works an example to estimate multiple correlation between three variables in combination and a criterion. His numerical result for the best combination is 0·83. The stereographic method gives proportions of 3, 2 and 1 as the values for approximate weighting of the three independent variables, 0·80 for the multiple correlation obtained by using these weights, and 0·72 as the correlation obtained by using unweighted scores. These examples are given to indicate the usual magnitude of error that has been observed by the Aptitude Testing Section of the R.A.A.F., where the method has been used for preliminary trials, the exact figure being afterwards computed for that particular combination which these trials show to be the best.

A theoretical justification of the procedure proposed for determining the multiple correlation may be given in terms of spherical trigonometry as follows. The deduction is based on a proof suggested by Prof. C. Burt; but the practical justification for the procedure proposed rests chiefly on its evident effectiveness as judged by a long series of trials with actual data. Actually, the use of the net for graphical work quite mechanical, and requires no special skill, ce the three-dimensional principle is appreciated. practice, the graph is plotted on transparent paper perimposed on the stereographic net, and rotated out the 'origin' by means of a pin stuck through e centre of the net.

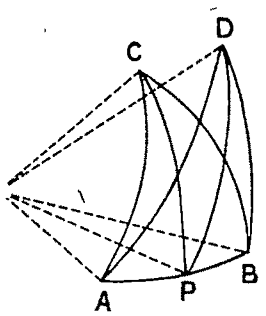

Fig. 1.

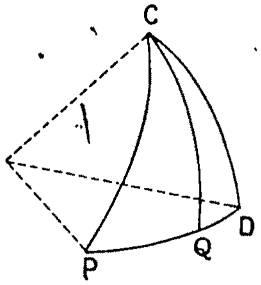

Fig. 2.

Consider a case of three tests A, B and D and iterion C.

Step 1. In Fig. 1, ABC is a spherical triangle the ides of which are made to represent the inter-orrelations of A, B and C, that is, the cosines of he arcs are the correlation coefficients. CP is drawn at right angles to AB. Then CP may be shown to represent the multiple correlation $R_{C(AB)}$, thus:

In the triangle ACP,

$$\sin \angle CAP = \frac{\sin \text{arc } CP \sin \angle CPA}{\sin \text{arc } AC}.$$

But $\sin \angle CPA = 1$. Hence the equation may be rewritten

$$\begin{aligned}
\sin \text{arc } CP &= \sin \text{arc } AC \sin \angle CAP, \\
\sin^2 \text{arc } CP &= \sin^2 \text{arc } AC \sin^2 \angle CAP, \\
1-\cos^2 \text{arc } CP &= (1-\cos^2 \text{arc } AC)(1-\cos^2 \angle CAP) \\
&= (1-r^2_{AC})(1-r^2_{CB.A}).
\end{aligned}$$

$$\text{But } R_{C(AB)} = \sqrt{\{1-(1-r^2_{AC})(1-r^2_{CB.A})\}}$$

$$\text{Hence } \cos CP = R_{C(AB)}.$$

Step 2. In Fig. 1, on the same base AB, the triangle ABD is drawn representing the relationship between the three variables A, B and D. D is joined to P, such that the arc DP now represents the relation between D and P (that is, the combination of A and B most closely related to C).

Step 3. A new spherical triangle is now drawn (for the sake of clarity) in Fig. 2. In this triangle the base is PD (transferred from Fig. 1), and the other sides are PC (also transferred from Fig. 1) and DC representing the relation between D and C. CQ is now drawn perpendicular to PD, meeting it in Q.

Now, in the triangle CPQ, we have

$$\sin \angle CPQ = \frac{\sin \text{arc } CQ \sin \angle CQP}{\sin \text{arc } PC}.$$

Since $\angle CQP$ is a right angle, this may be rewritten:

$$\sin \text{arc } CQ = \sin \angle CPQ \sin \text{arc } PC.$$

But in Step 1 we have already shown that $\sin \text{arc } PC = \sin \text{arc } AC \sin \angle CAP$.

$$\text{Therefore, } \sin \text{arc } CQ = \sin \angle CPQ \sin \text{arc } AC \sin \angle CAP.$$

$$\text{Therefore, } 1-\cos^2 \text{arc } CQ = (1-\cos^2 \angle CPQ)(1-\cos^2 \text{arc } AC)(1-\cos^2 \angle CAP).$$

Now $\cos \angle CAP = r_{CB.A}$, and similarly $\cos \angle CPQ = r_{CD.P}$; or, in other words, $r_{CD.AB}$, since P may be taken as representing A and B simultaneously. (This is, of course, only an approximation. P represents the *weighted* sum of A and B, and eliminating a weighted combination is not quite the same as eliminating A and B by the usual formula.)

Cos arc AC is, of course, r_{AC}.

Hence the equation becomes:

$$\cos \text{arc } CQ = \sqrt{\{1-(1-r^2_{CD.AB})(1-r^2_{AC})(1-r^2_{CB.A})\}}.$$

This is in the form of the equation for multiple correlation; and yields a procedure for estimating $R_{C(PD)}$ as an approximation to the true multiple correlation $R_{C(ABD)}$.

As pointed out earlier, the weights to be attributed to each test are represented inversely by the cosines of the base angles. (With the stereographic net, the cosine values may be obtained by the use of the 'meridians' as distinct from the 'parallels'. Another approximation is involved here at stages *beyond the first combination*, for then the partial regression coefficients are not quite equal to the partial correlations.) Thus, the relative weights for A and B used in the combination can be obtained exactly from the triangle ABC while the proportion of weighting of (AB) to D can be obtained from the base angles of the triangle PCD (Fig. 2). From this, the composite weighting for A, B and D can easily be estimated. This also will not be quite exact as the relative weights of A and B will be the same in the final result as they were before test D was added to the combination. However, since A and B are the tests making the greatest contribution, it is clear that the total error involved will be small; and less than that which would occur if the tests were combined without regard to weighting at all.

A simple extension of this method in which instead of perpendiculars, lines (arcs of great circles) are drawn from the vertices to the mid-point of the base, enables a value to be estimated for the multiple correlation coefficient which would be obtained by combining the tests in equal proportions. This may, if necessary, be compared with that obtained by the more accurate method in order to establish the advantage in the particular circumstances of using the weighted as distinct from the unweighted test combination.

In the case of analysing the relationships between tests of a large battery, the process of projecting them as points with reference to a base-line consisting of any two of the variables is quite illuminating, especially if something definite is already known about the variables used as the base. By changing the base several times and replotting, the tendency of certain tests to form 'inseparable' pairs or groups may be qualitatively and quantitatively examined.

I gratefully acknowledge the assistance given by Prof. Cyril Burt in discussing the problems considered in this paper, but do not wish him to be held responsible for any inconsistencies in the final presentation.

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[1] *Phil. Trans. Roy. Soc.*, A, 200, 1 (1902).

[2] "Textbook of Statistical Method", 291–310 (1923).

[3] "Factors of the Mind", 81, 88 and refs. (1940).

[4] Holzinger, "Statistical Methods for Students in Education", 309.

[5] Garrett, "Statistics in Psychology and Education" (2nd edition), 438–39.

INDIGENOUS FORESTS OF NEW ZEALAND

IT is rather illuminating to realize that some of our English characteristics are just as strong in a Dominion. The 'hands off the New Forest' controversy when the Forestry Commission suggested undertaking certain operations will be remembered. Beauty spots in that region or elsewhere in Great Britain may chiefly depend upon the presence of a clump or block of old trees—very beautiful things. The argument is that it would be desecration to touch them. Since the trees will not stand for ever, this means that our children or grandchildren will never see that particular beauty spot.

In the report for 1944 of the New Zealand State Forest Service (Gov. Printer, Wellington, 1944) the attitude has arisen on a larger scale. New Zealand has still left a considerable area of its old indigenous forests, although exotic conifers have been planted on a very extensive scale. Arising from the admirable soil conservation schemes now under consideration in the Dominion is one aspect which constitutes a serious threat to these national forests. It is the 'hands off' policy once again. "Well meaning but unrealistic enthusiasts," says the report, "advocate a lock-up-use-not policy of forest reservation, under the mistaken impression that such a practice will perpetuate the principal indigenous species—such as rimu, matai, etc. The exact reverse would occur in most forests. Why do so many of our rimu forests consist of virtually only old trees with seedlings and medium-age trees so few as to be insignificant? The initial cause is the fact that, no matter how prolifically the old trees seed, the humus on the floor is so thick that even when the seeds germinate, roots are seldom able to penetrate to the mineral soil beneath, and most seedlings therefore die." The Director of Forestry, continuing, points out that owing to the density of shade such seedlings as do develop gradually die from want of light, while in other parts of the forests inferior species capable of standing more shade are ousting the more valuable ones.

The Director deals with the whole matter clearly, giving a sylvicultural exposition with which a forestry student is well acquainted at the end of his first year's study—data so little known in spite of their elementary nature that ignorance thereof is imperilling the future of the Dominion's indigenous forests. Controlled logging and fire protection are advocated as the methods to be introduced. It is the logging, that is, felling any of the trees, which the opponents object to. The answer is a condemned and disappearing forest.

In connexion with this logging in indigenous forest, an almost inevitable discovery has been made, meriting consideration outside New Zealand. New plywood factories were to provide plywood for defence works and a junior technical officer of the Forest Service was stationed at one of these to assist in the solution of current problems in the manufacture of both casein- and resin-bonded plywood for defence works. Marked advances in manufacturing technique have been made, but there is said to be room for improvement. The tentative conclusion has been arrived at that the high moisture content of rimu and other indigenous logs makes it extremely difficult to dry their veneers in standard driers and at the rates, temperatures and humidities usually employed in plywood manufacture. On the subject of peeler-logs, it has been established that t quality of the local product, if it is to comp successfully with imported plywoods on a qual basis, will have to be improved. Straightness grain and reasonable freedom from defects essential to the production of sheets free from tw and warp, etc.

This applies equally to the logs used in the plywo mills in Britain, where most of the material used imported. It is the forest officer's business to s that only suitable logs are ear-marked for plywo conversion. As to the standard driers, New Zeala might learn something in this direction from Ind at the Forest Research Institute, Dehra Dun; f departures from European practice both in patte of drier, temperatures, humidities and length of tin of remaining in the drier are in practice in th country.

E. P. STEBBING.

BRITISH ARMY VETERINARY SERVICES IN THE FAR EAST

A PREVIOUS note (*Nature*, Jan. 13, 1945, p. 6 described the great responsibilities and hig quality of the work of the Army Veterinary Servic in the Near East. In the Far East, says Brigadie E. S. W. Peatt (*Vet. Record*, May 12, 1945, p. 219 even greater responsibilities are being undertake The campaign in Burma made necessary a return t animal transport, and this fact, together with th duty of providing fresh meat for the troops, mad necessary an organization for the care of a grea variety of animals. The result has been that th British and Indian veterinary personnel has increase to ten times its pre-war strength and further increase are likely.

Adequate training in veterinary tropical medicine was an early problem, and in October 1942 the Indian Army Veterinary Corps Training Centre was established. Its Officers' Training School now gives a training lasting two months to fifty officers at a time and its training wing gives to 1,200 men at a time a course lasting five months. Both courses are designed to produce competent soldiers as well as competent veterinary personnel, because the necessity of military as well as veterinary training has often been demonstrated in the fighting in Burma and Arakan. Farriers are trained in the Army Veterinary School; the classes consist of twenty-four students and extend over sixteen weeks, this training being continuous throughout the year. The same School gives continuous instruction in veterinary first-aid, animal management and the care of cattle, sheep and goats purchased for slaughter.

The care of transport animals used for military purposes involves the care of horses, mules and donkeys used in operational areas; the care of bullocks used on peace stations so that horses and mules can be released for operational work; the care of the camels, which are restricted by climatic conditions to the North-West Frontier and the Punjab; and the care of elephants used in the Burmese jungle. But, in addition to all this work, the Army Veterinary Service has the important responsibility of the control of the military dairy farms, and it has been necessary to set up a separate veterinary organization to deal with these. The Military Dairy Farms Department has increased its milch cattle from 10,000 to more than 60,000, and to-day it is probably the biggest ry organization in the world. Although there are) million cattle in India, the provision of fresh at for the troops is made more than usually ficult by the climate, the enormous distances olved, the many infectious diseases and the fact at Indian animals are not bred and fattened for ughter. Several hundred thousand animals are ught each year for slaughter, and the Army terinary Service examines and selects them and res for their health. Many animals must spend m three to ten days in the train before they reach eir destinations. Slaughter stock are transported sea voyages which may last from one to five days, train, by motor, on foot or by a combination of four methods; and the hot weather, traffic con- stion, compulsory use of all-metal wagons and her factors increase the difficulties of organizing ch journeys. Animals are never kept in the train r longer than forty-eight hours; but the rests be- een spells of travelling expose them to the many fectious diseases of the Far East.

A further responsibility of the Army Veterinary rvice is the breeding, through local development hemes, of pigs, rabbits and poultry, and these imals present their own disease problems. The rmy Veterinary Service also inspects the meat and rovides the Veterinary Wing of the Chemical Defence esearch Establishment, which deals with the defence f animals against gas warfare. The Army Veterinary aboratory Services and their mobile laboratories repare vaccines and undertake routine and other iagnostic work. Nowhere else in the world, says rigadier Peatt, does the veterinary officer encounter uch a variety of diseases. A good example of the ilitary importance of these diseases is the outbreak f the equine trypanosomiasis called 'surra' in 1942 n the Assam-Burma border. At one time 17 per ent of the horses and mules were put out of action y this disease, but the control measures adopted educed the percentage of infected animals from 17 per cent in 1942 to 7 per cent in 1943 and 2 per ent in 1944. The Army Veterinary Service devised the method of injecting 'Antrypol' intravenously and obtained by this method 90 per cent of recoveries from this disease. Anti-surra units have now been formed.

Two other important diseases are anthrax and rinderpest, against both of which all cattle purchased and many sheep and goats are immunized. Rinderpest is the most important cattle disease in India. Although many thousands of cattle owned by civilians have died near the military dairy farms, the losses on these farms have been negligible (less than 1 per cent in 1943–44). Outbreaks of glanders have been quickly controlled, epizootic lymphangitis and strangles are being studied, precautions against foot-and-mouth disease, which is extremely widespread in India, are being taken, and the control of variola, which is usually introduced to dairy farms by buffaloes which have been bought, is being improved. Among the serious diseases of the smaller animals are pasteurellosis, salmonellosis and Ranikhet (Newcastle or Doyle's disease), and research upon the control of these is being done.

It is clear that the Army Veterinary Service is doing in the Far East a fine job which is vital to the success of the war against Japan. The quiet efficiency and progressive spirit of this work show how much the veterinary profession can contribute to the solution of the vast food problems of the post-war world.

G. LAPAGE.

ARTS AND CRAFTS OF THE COOK ISLANDS

In a large and profusely illustrated volume the Director of the Bishop Museum gives a comprehensive and detailed account of the material culture of the Cook Islands*. The Polynesians are known for their clever workmanship and, as the illustrations show, these islanders are no exception, whether they are carving wood or plaiting fibres. The greater portion of the book is concerned with a description of the arts and crafts, including religious symbols, and this is followed by a discussion of their implications.

A study of the material culture of the Cook Islands shows that there are three cultural periods, a fact that may be best understood by the racial history of its inhabitants. The Polynesian ancestors, as it is now recognized, came from the mainland of Asia into Indonesia where they adjusted their continental culture to suit volcanic islands the fertile soil of which produced abundant food and where a rich culture developed. From Indonesia they passed on to Micronesia, the coral atolls of which formed a barren contrast; arts and crafts suffered drastic changes owing to the loss of food plants and raw material of wood and stone, and the people retrogressed from the stone age to a shell age. From here these ancestors, in the course of ages, moved westwards and finally arrived at the Society Islands, where they were once more on volcanic soil, so that stone was again available and the rich soil provided ample food. On these islands the Polynesians settled and from them they radiated out to the various island groups they were destined to colonize. They rediscovered the use of stone, and food plants and animals were probably introduced from the Melanesians in Fiji.

It was in this period of expansion that the Cook Islands were settled—roughly six hundred years ago—the culture being identical with that of the parent colony of the Society Islands, and this forms the first phase. Modifications and local developments have naturally taken place in both island groups so that it is difficult to give an exact picture of this early stage, but certain elements can be reconstructed. Some cultural processes, which may be regarded as stable, persisted unchanged until European occupation; examples of these are the plough method of firemaking and the earth-oven. The second period was one of developments rather than of any very sudden change. These may be due to diffusion owing to migration or importation or they may be caused by the substitution of another material or technique. Occasionally a new local technique is invented, such as the decorated borders to the pandanus sleeping mats that are peculiar to the Cook Islands.

The third period begins with the arrival of the white people. Early European voyagers bartered hoop iron and axes for fresh food, and the natives were quick to realize the superiority of metal over stone and to acquire it whenever possible. With the coming of the missionaries clothing was altered both in design and in material, and as time went on most of the old culture became obsolete. The new generation has grown up under these changed conditions and the cultural invasion is firmly established, for the natives will not give up the material comforts of to-day for any mental satisfaction connected with a sentimental past.

K. RISHBETH.

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* Arts and Crafts of the Cook Islands. By Te Rangi Hiroa (Peter H. Buck), Bernice P. Bishop Museum Bull. 179 (1944).

FORTHCOMING EVENTS

Wednesday, July 18

Institution of Mining Engineers (at the Midland Counties Institution of Engineers, Nottingham)—Fifty-first Annual General Meeting. Mr. T. E. B. Young and Mr. W. H. Sansom: "Simultaneous Cutter and Loader for Longwall Mining".

Royal Institute of Chemistry (Birmingham and Midlands Section) (in the English Theatre, The University, Edmund Street, Birmingham), at 6.30 p.m.—Dr. Dorothy Jordan-Lloyd: "Protein Fibres".

Friday, July 20

Biochemical Society (in the School of Medicine, Thoresby Place, Leeds 2), at 2.30 p.m.—Scientific Papers.

# APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Teacher of General Engineering Subjects (including Electrical), in the Bootle Municipal Technical College and Boys' Secondary School (Trinity)—The Director of Education, Education Offices, Town Hall, Bootle (July 20).

Civil Engineers by Control Commission for Germany: (*a*) Assistant Controllers (Ref. E.1677 A) with wide experience in Civil Engineering Design and Construction, including Water Supply, Sewage Disposal, Civil Engineering Plant and Building Construction; (*b*) Chief and Senior Technical Assistants (Ref. E 1680.A) with good experience in Civil Engineering work in some or all of the following—Water Supply, Sewage Disposal, Civil Engineering Plant, Building Construction, Demolition and Recovery of Salvaged Material—The Ministry of Labour and National Service, Room 670, York House, Kingsway, London, W.C.2, quoting the appropriate Ref. No. (July 20).

Lecturer in Mathematics—The Principal, Derby Technical College, Normanton Road, Derby (July 20).

Lecturer in Mechanical Engineering with special knowledge of Hydraulics and/or Aeronautics, a Lecturer in Mechanical Engineering, and a Lecturer in Engineering Drawing—The Clerk to the Governing Body, Battersea Polytechnic, Battersea, London, S.W.11 (July 21).

Lecturer in Physiology and Anatomy, mainly to Sister Tutors—The Clerk to the Governors, South-West Essex Technical College and School of Art, Forest Road, Walthamstow, London, E.17 (July 21).

Teachers (2) for Science and Mathematics at the East Ham Technical College—The Chief Education Officer, Education Office, Town Hall Annexe, Barking Road, London, E.6 (July 21).

Assistant (temporary) to the Advisory Bacteriologist—The Secretary, Edinburgh and East of Scotland College of Agriculture, 13 George Square, Edinburgh 8 (July 21).

Assistant Lecturer in Physics, and a Demonstrator in Zoology—The Registrar, University College, Nottingham (July 21).

Teachers of Engineering Subjects with special qualifications in (*a*) Heat Engines, (*b*) Electrical Engineering, and (*c*) Production Engineering, in the Municipal College—The Chief Education Officer, 215 High Street, Smethwick (July 23).

Lecturer in Economics—The Secretary, Queen's University, Belfast (July 24).

Transport and Mechanical Engineering Assistant (temporary)—The Town Clerk, Town Hall, Camberwell, London, S.E.5 (July 25).

Chair of Pharmacology, tenable at the College of the Pharmaceutical Society—The Academic Registrar, University of London, Richmond College, Richmond, Surrey (July 26).

Assistant Municipal Engineer by the Accra Town Council, Gold Coast—The Ministry of Labour and National Service, Appointments Department A.9, Room 670, York House, Kingsway, London, W.C.2, quoting E.1174.A (July 27).

Engineers, Physicists and Applied Mathematicians at the Building Research Station, Garston, Watford, for research and other technical work on Building—The Ministry of Labour and National Service, Appointments Department A.9, Room 670, York House, Kingsway, London, W.C.2, quoting D.S.I.R. (July 28).

Deputy Secretary—The Secretary, Institute of Fuel, 30 Bramham Gardens, London, S.W.5 (endorsed 'Deputy Secretary') (July 30).

Assistant in Botany—The Secretary, The University, Aberdeen (July 30).

Assistant Engineers—The Clerk to the Metropolitan Water Board, New River Head, Rosebery Avenue, London, E.C.1 (endorsed 'Assistant Engineer') (July 31).

Educational Psychologist (part-time) at the Preston Child Guidance Clinic—The Director of Education, Municipal Building, Preston (August 9).

Lecturer in Mathematics in the University of Tasmania—The Agent-General for Tasmania, Australia House, Aldwych, London, W.C.2 (August 15).

Assistant Registrar—The Registrar, The University, Liverpool (August 15).

Principal of the Sir John Cass Technical Institute—The Correspondent, Sir John Cass's Foundation, 31 Jewry Street, London, E.C.3 (August 31).

Professor of Metallurgy—The Registrar, King's College, Newcastle-upon-Tyne (August 31).

Secretary and Librarian—The Director, Institute of Historical Research (University of London), Tavistock House South, Tavistock Square, London, W.C.1 (August 31).

Medical Officer to the University—The Secretary, The University, Edmund Street, Birmingham, 3 (September 3).

Lecturer in Dental Pathology and Bacteriology—The Registrar, The University, Liverpool (September 30).

Grade III Assistant Lecturers (2) in Applied Mathematics—The Registrar, The University, Liverpool (October 1).

Nuffield Chair of Child Health, tenable at the Institute Child Health—The Academic Registrar, University of London, Ri mond College, Richmond, Surrey (October 1).

Chair of Moral Philosophy—The Secretary of University Cou The University, Glasgow (October 15).

Lecturers in Natural History, Natural Philosophy, Chem try, Mathematics, and Statistics—The Secretary, The Universit Aberdeen (October 15).

Teacher of Mathematics and English with History or Ge graphy as subsidiary, and Teachers (2) of Engineering Subjec (Mathematics, Science and Drawing) up to National Certifica standard—Miss P. E. Roberts, Art and Technical Institute, Yeov Somerset.

Lecturer in Physical Chemistry in the Victoria Universi College, Wellington, New Zealand—The Secretary, Universiti Bureau of the British Empire, c/o University College, Gower Stre London, W.C.1.

Chief Laboratory Steward in the Chemistry Department—The Clerk to the Governors, Woolwich Polytechnic, Woolwich, Londo S.E.18.

Industrial Investigators (graduates, men or women), a Vocational Advisers (graduates, men or women)—The Directo National Institute of Industrial Psychology, Aldwych House, Aldwyc London, W.C.2.

Adviser in Psychology to the Government of India in the Ho Department—The Secretary, India and Burma Recruitment, Ind Office, Whitehall, London, S.W.1.

Head of the Biology Department—The Principal, Harper Adam Agricultural College, Newport, Shropshire.

Assistant Masters (*a*) to teach Mathematics in the Junior Tec nical School and to day-time released students up to Higher Nation Certificate standard, (*b*) to teach Physics and Chemistry in th Junior Technical School and Chemistry to part-time students up t National Certificate standard, in the Corby Monotechnic Institut and Junior Technical School—The Chief Education Officer, Count Education Offices, Northampton.

Assistant Chemist at the Langford Treatment Plant and Labora tory, Maldon—The Engineer, Southend Waterworks Company, 1 Cambridge Road, Southend-on-Sea.

REPORTS and other PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Scientific Proceedings of the Royal Dublin Society. Vol. 24 (N.S.), No. 2: Observations on *Gibbirella saubinetti* (Mont.) Sacc. on Cereals in Ireland in 1943 and 1944. By Dr. Robert McKay and James B. Loughnane. Pp. 10+1 plate. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd., 1945.) 1*s.* 6*d.* [26

Gas Research Board. Fifth Annual Report 1943–1944. (Communication G.R.B. 11.) Pp. 54. (London: Gas Research Board, 1944.) [96

Medical Research Council. War Memorandum No. 14: Nutritive Values of Wartime Foods. Tables compiled for the Accessory Food Factors Committee. Pp. 60. (London: H.M. Stationery Office, 1945.) 1*s.* net. [116

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NATURE

No. 3951 SATURDAY, JULY 21, 1945 Vol. 156

CONTENTS

Page
Science and National Defence 63
Chemical Analysis and Structural Diagnosis by Infra-Red Absorption. By Dr. H. W. Thompson . . 65
Symposium on India. By Prof. J. H. Hutton, C.I.E. . 66
Functions of a Complex Variable. By J. H. Pearce . 67
Electron Shadow-Micrographs of Hæmocyanin Molecules. By Prof. Robley C. Williams and Dr. Ralph W. G. Wyckoff 68
Some Factors Concerned in the Process of Starch Storage in the Barley Grain. By H. K. Archbold . 70

Obituaries :

Prof. Leif Tronstad, O.B.E. By Prof. E. K. Rideal, M.B.E., F.R.S., and Dr. U. R. Evans . . . 74
Don Ignacio Bolivar y Urrutia. By Dr. B. P. Uvarov, C.M.G. 74
Dr. G. C. Robson. By Dr. E. Hindle, F.R.S. . 75
Some Czechoslovak Men of Science. By Dr. G. Druce 75
News and Views 76

Letters to the Editors :

Anaerobic Metabolism of Spermatozoa.—Dr. T. Mann 80
Double-Refringence of the Amyloid-Congo-Red-Complex in Histological Sections.—Dr. Peter Ladewig 81
Stabilization of Penicillin Solutions by Phosphate.—Lieut.-Colonel R. J. V. Pulvertaft and Capt. John Yudkin 82
Structure of Dibenzyl.—Dr. G. A. Jeffrey . . 82
Crystal Structure of Diamond.—G. N. Ramachandran 83
Energy Spectrum of Mesotrons at Low Energies.—S. K. Ghosh and N. N. Das Gupta 83
Production of Difference Tones.—Prof. Frank Allen 84
Units for Degree of Vacuum.—Dr. R. Feinberg ; G. A. P. Wyllie 85
Hexachlorocyclohexane as an Insecticide.—L. B. Bourne 85
The Vitamin B_2 Complex 86
Genetic Types of Manganese Deposits. By Prof. Arthur Holmes, F.R.S. 87
Cheshunt Experimental Station 88
Structure of Biological Fibres and the Problem of Muscle 89
Meter and Instrument Jewels and Pivots 89

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SCIENCE AND NATIONAL DEFENCE*

IMPORTANT as it is that there should be worked out as speedily as possible an adequate national defence policy embodying all the lessons and experience of the last five years, no such policy can be formulated in isolation. It should be ensured of the support of all political parties in Britain, and it must also be related to the policies of other members of the British Commonwealth and of the United Nations. That much was clearly recognized in the debates in the House of Lords, in Lord Vansittart's plea for a permanent Inter-Allied Committee of Scientists to examine and control the use of any scientific discovery or invention considered dangerous to the safety of mankind, in Lord Strabolgi's proposal for pooling knowledge of scientific discoveries and inventions, in Lord Cherwell's reply, and in Lord Brabazon's plea for an international committee with full powers of investigation anywhere in the world. What is encouraging, however, is the evidence of the extent to which these problems are already occupying the minds of others of the United Nations, and notably in the United States.

The parallel in thought between the report of the Select Committee on National Expenditure and the address of the Hon. Robert P. Patterson, U.S. Under-Secretary for War, on "Science and Industry in National Security" (see *Nature*, 154, 785 ; 1944) is unmistakable. A recommendation for the establishment within the National Academy of Sciences of a Research Board for National Security has already come from the Committee on Post-War Research, as was stated by the U.S. Secretaries of War and the Navy on February 12, 1945, in which these facts are recognized. Further, Dr. J. B. Conant has lent the weight of his authority to a proposal for the establishment of an international civilian technical inspectorate in which a tradition might be built up anchoring professional loyalties to an association of nations. Dr. Vannebar Bush in his recent report as president of the Carnegie Institution of Washington touches briefly on this same question of defence and its relation to scientific research, and the imperative necessity of continuing attention to the possible military applications of expanding science. Different aspects of the problem are also discussed in an able article, "Science and Foreign Policy", by the American expert, Mr. G. Fielding Elliot, in *Foreign Affairs* of April last, from which Lord Vansittart quoted, and in the study, "The Control of Germany and Japan", by H. G. Moulton and L. Marlio, which the Brookings Institution of Washington published last year.

Mr. Elliot raises the fundamental question whether the discoveries of science must not now become the common property of all for the use of all, and whether we can afford any longer to tolerate private research for military purposes, or commercial processes serving those purposes. The robot-bomb, the rocket and the jet-propelled plane demonstrated the dangers which must be guarded against, and no international organization for world security will be adequate which does not possess the ability to deal with such dangers at the source.

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* *Continued from p. 31.*

Mr. Elliot urges that the foundation of successful partnership in international affairs, as elsewhere, is good faith and mutual confidence ; and he suggests therefore that the first step to security is the exchange of full information regarding the armed forces. Already we have seen that modern warfare involves the mobilization of all national resources, and that science has introduced into warfare a succession of new weapons of steadily increasing range, speed and destructiveness. Nevertheless, Mr. Elliot believes—and the trend of Lord Cherwell's speech would seem to indicate his concurrence—that if the results of the labours of all scientific men in the peace-loving States were pooled, the chance of sudden surprise would be greatly reduced, since science in different countries generally advances on parallel lines.

Mr. Elliot does not ignore the difficulties that may have to be overcome in securing the complete and continuous interchange of information on the progress of scientific research among the United Nations. He puts a question mark against the attitude of the U.S.S.R., though here the appointment of Prof. Eric Ashby as scientific attaché at the Australian Legation in Moscow may mark the beginning of some closer contact between that country and the Western nations. The matter is so important that it is all the more unfortunate that the Government should have considered it necessary on any ground to refuse exit permits to British men of science who had accepted invitations to attend the two hundred and twentieth anniversary celebrations of the Soviet Academy of Sciences.

Mr. Elliot points out clearly all that is involved in such interchange—freedom of communication, travel, the Press, radio, and academic and scientific interchange—and if such a policy is the soundest from the point of view of national defence, it is the policy also which is most stimulating to creative thought and fundamental research. Such objectives are widely recognized as claiming the steady support of all scientific workers, but to attain them much more will be required than the maintenance of the machinery for Anglo-American collaboration and exchange of scientific and technical information set up during the War, or even the relaxation of the censorship. Much will depend on the readiness with which the U.S.S.R. abandons her 'Chinese wall', and clear thinking will be required to deal with the problems which arise out of the relation between scientific research prompted by commercial competition and military affairs, patent law and the like. Mr. Elliot notes that we must be prepared to find that the solution may involve much loss of individual freedom and some curtailment of the search for commercial or military advantage.

Only some of the problems that arise in the technical control of Germany and Japan are indicated very briefly by Mr. Elliot. Those problems are closely analysed in a recent book* by Dr. H. G. Moulton and Dr. L. Marlio, who, considering first the lessons of the Treaty of Versailles, suggest th measures for economic control must be based on tw guiding principles : first, the economic devices mus not be permitted to throttle the economic life of th country on which they are imposed ; and secondly the measures selected must be administratively feasible and relatively easy to enforce. On these ground they regard, for example, the complete destruction o the chemical industry of Germany as impracticable the only strategically key industry which holds sufficient possibilities of effective control to merit favou able consideration is the electric-power industry.

Drs. Moulton and Marlio reject the idea of permanent military occupation as well as of economi controls, and propose that reliance should be place upon a system of detection and coercion by punitiv measures if infringements are discovered. For thi purpose they propose the creation of a Rearmamen Detection and Prevention Board comprised chiefly o military officials, and in the nature of an extension o the war-time Combined Staff Organization. The Boar would be the executive agency for the general policie and procedures regarding military controls determined by the governments at its establishment, bu it should possess the power of independent action within the field so defined. It should be empowered to maintain within key industrial areas sufficient supervisors to detect evasions of the disarmament provisions, to direct the attention of the German or Japanese Government to any evasions discovered and to apply the necessary coercive measures if such warning is not promptly heeded.

There may be some grounds for doubt as to whether we can wisely rely on a system of detection and coercion alone ; Drs. Moulton and Marlio are not altogether convincing in their demonstration of the impracticability of economic control, and their two principles can be stretched too far ; but that some measure of inspection must be worked out and systematically applied is scarcely open to challenge. Any such system will almost certainly function more effectively when the free interchange of scientific and technical information and exchange of personnel is carefully fostered ; and for this reason the development of the British Central Scientific Office in Washington, the American Scientific Office in London, the Anglo-Soviet Science Collaboration Committee and the Scientific Co-operation Office of the British Council in China into something of an international science co-operation service, as suggested by Dr. J. Needham (*Nature*, 154, 657 ; 1944), may be a measure of the first importance from the point of view of defence.

It is for men of science to stress the importance of this aspect of the matter at the present time. Mr. Lyttleton, in the House of Commons on June 13, admitted that the free flow of scientific information in an industry is absolutely necessary. The free flow of scientific and technical data in a nation and between nations is equally essential to world security, and to encourage, as Sir Arrol Moir suggested in the *Engineer* of June 2, the fullest possible inventiveness in time of peace.

Rapid progress in this matter, as Mr. Elliot observes, can scarcely be expected, but scientific orkers should miss no opportunity of educating oth public opinion and Government as to its nportance. A system of scientific attachés could do uch to stimulate the free flow and interchange of formation and of men and women, and to avoid cidents like that in connexion with the Soviet cademy of Sciences, which tend to jeopardize good elations. But while endeavouring to secure a wider nderstanding of the contribution of science to ational defence and the conditions in which that ontribution can be made most effectively, they hould lend the full weight of their influence as itizens to secure urgent attention to the formulation f defence policy on lines above the turmoil of party olitics, and to stimulate the clear thinking required. They could help in emphasizing certain principles which an adequate defence policy must embody : the retention of an adequate Combined Staffs Organization, not only of the different armed services but at least between Britain, the United States and the U.S.S.R. ; the determination of the peace strength of the armed forces in accordance with the possible rate of development of full war potential, the strength of the other principal Powers and our geographical strength, and in appropriate relation with our foreign policy, so that strength which can only be changed very slowly is in accord with policy, so far as that can be set by looking well ahead.

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* The Control of Germany and Japan. By Harold G. Moulton and Louis Marlio. Pp. xi+116. (Washington, D.C.: Brookings Institution; London: Faber and Faber, Ltd., 1944.) 10s. net

These are some of the principles emerging from the experience of the last twenty-five years ; and the Select Committee's recent report provides scientific workers with admirable material for their task of education. That there should be so much evidence on both sides of the Atlantic that the same conclusions are being reached provides ground for the hope that there will this time be thrashed out a national policy for defence which is in harmony with our commitments and our foreign policy, in which the various elements are in balance one with another and appropriate use is made of all the nation's resources of materials, man-power and intellect. No defence policy, no system for the control of Germany or Japan, will be effective which does not provide for attracting men of the highest ability into the armed services and the scientific and technical services of the United Nations, for the adequate prosecution of research and encouragement of inventive ability, and for the fullest and widest possible dissemination of scientific and technical information. Closer co-ordination is essential between the departments and other agencies or institutions within Great Britain and with such organizations as the National Academy of Sciences, the National Research Council, and the Office of Scientific Research and Development in the United States, possibly through a Central Scientific and Technical Board as suggested at the recent Conference of the Association of Scientific Workers. The free exchange of knowledge across national boundaries, upon which creative thought has always largely depended, and which now may well provide one of the strongest safeguards against those dangers of which the robot-plane and the long-range rocket have given so dire a warning, is still one of the fundamentals of a free society.

CHEMICAL ANALYSIS AND STRUCTURAL DIAGNOSIS BY INFRA-RED ABSORPTION

Infrared Spectroscopy

Industrial Applications and Bibliography. By R. Bowling Barnes, Robert C. Gore, Urner Liddel and Van Zandt Williams. Pp. vi+236. (New York: Reinhold Publishing Corporation, 1944.) 2.25 dollars.

THAT modern wars lead to scientific development is a commonplace more vividly borne out in the present War than in any other. Now that the silences may be broken, applications of physical techniques become evident which may be equally important in times of peace. Infra-red spectroscopy has been transformed during recent years from a delicate and exacting technique into a more easily controllable robust tool, which will be of great value in the future for both pure and applied science. Some indications of this have been shown by discussions such as that recently organized by the Faraday Society.

The limitations of secrecy imposed in different lands have varied, and still delay publication of many developments. Dr. Barnes and his colleagues, well known for their past work in the infra-red, and now members of the research laboratory of a leading industrial firm in America, have given us one of the first manuals for workers in this field, and particularly for those who will use infra-red absorption as an analytical technique. The first part of their book is a reprint of a lengthy paper published recently in *Industrial and Engineering Chemistry*, in which the theoretical and experimental principles of infra-red measurements were described, and a range of the spectrum of each of a very large number of molecules was shown graphically for purposes of reference. To this the authors have now added a detailed and excellent bibliography of the subject, which should be valuable to specialists and non-specialists alike.

Infra-red absorption can be applied to the qualitative and quantitative analysis of mixtures of substances, but it can also be used for diagnostic purposes as well. The vibration frequencies of a molecule, which correspond with absorption bands in the near infra-red, are determined in magnitude by the masses of the atomic nuclei and the forces between them, that is, the strengths of the bonds. It follows that molecules with different nuclear configurations will have a different set of vibrational modes, and since all molecules other than a pair of optical enantiomorphs differ in nuclear configuration, the infra-red spectrum can be regarded as a fingerprint of the molecule. Indeed, it is probable that this vibrational spectrum is the most characteristic physical property of a molecule yet measured. In order to analyse a mixture of substances it will simply be necessary to know the spectra of the pure components present. Unless special interactions occur, the spectrum of the mixture is got by simply superposing those of the individual components with the appropriate intensities, and the key bands can therefore be used for either qualitative or quantitative estimation of the individual components.

In spite of this individualistic character of the infra-red spectrum, some linkages or small nuclear skeletons give rise to vibrational frequencies which are not much affected by the remainder of the molecule. In some cases the reason for this is obvious.

Thus, with bonds such as C—H, O—H, or N—H, the light hydrogen atom oscillates against a much heavier residue, the mass of which has little effect on the oscillation frequency. Each of these linkages therefore retains a roughly constant vibration frequency when present in different molecules. The same applies, even if to a less degree, to some other linkages such as the carbon-carbon double bond or the carbonyl group, and a measurement of how much these frequencies deviate from 'normal' values may give a clue to the nature of the rest of the molecule. In some cases, a roughly constant set of frequencies can be associated with a given set of atoms arranged in a definite manner. These are the bases of structural diagnosis.

The authors of this book have explained these principles clearly and in a way which will appeal to those who are wishing to apply a new method of which they have only fragmentary knowledge. They have described an instrument suitable for most industrial work, with the relevant accessories, and have discussed critically the various difficulties which have to be overcome in obtaining accurate results. They have given examples of analyses of different kinds in which either the standard absorption laws can be used, or in which empirical calibration charts have to be set up because of the breakdown of these absorption laws as a result of intermolecular interactions. By means of typical examples they have also considered carefully the magnitude of errors likely to arise in practice.

All these features make the book an admirable introduction to the subject. At the same time there are several points to which the attention of the inexperienced reader should be directed. For example, although the spectrometer described is a good one, marked recent improvements in both thermocouples and recording systems not referred to in this book should perhaps now be taken into account. One of the disadvantages of a single-beam automatic recorder is the fact that absorption bands usually have to be measured against the background energy of the emitter in air. This background of energy will in any event fall in moving towards longer wave-lengths, but in addition the absorption by atmospheric water vapour and carbon dioxide gives rise to a very irregular background over some spectral regions, and in these regions the quantitative measurement of the absorption by a substance is very difficult. The difficulty can be avoided by using vacuum spectrometers, or minimized by the copious use of drying agents, but neither procedure has proved very satisfactory. The most recent way of obviating the trouble is to use a spectrometer in which two equivalent beams of radiation traverse the instrument, one being used as a blank and the absorbing material being placed in the other. After emerging from the spectrometer, each of the beams is directed on to a sensitive thermocouple. The electromotive forces produced are then amplified separately by D.C. amplifiers and finally fed into a potentiometric recorder having a high speed of response, and so devised that a continuous record is obtained directly of the percentage absorption. Several other types of recording device have been tried recently and it may yet be early to decide which is the most serviceable for all purposes, but there seems little doubt that as regards spectrometers the double-beam system has established itself.

The spectral curves shown in this book suffer from the disadvantage that most of them do not extend to wave-lengths beyond 10 μ, or 1000 wa numbers, whereas it is outside this range, namel between 1000–500 wave numbers, that many of t most useful key bands for analytical work are to found. Also it might be inferred from the limit range shown of the spectra of some of the simpl hydrocarbons that suitable key bands for the compounds are hard to find, whereas a more extende study of their spectra leads to the reverse conclusio In the same way experience has shown that a stud of the range of lower frequencies leads to valuab structural correlations.

The authors have wisely directed attention to t fact that curves such as they have shown must n be used directly by other laboratories for quantitativ work depending on intensities, since instrument factors such as resolving power, or impure spectra du to scattering of radiation will lead to inapplicability It is difficult at present to see how this gener difficulty may be overcome, since it implies that eac laboratory must have pure compounds for calibratio work. In some cases high purity may not be essentia but in others it has been found that very sma amounts of contaminants are easily detected in th infra-red spectrum. Indeed, some of the curves show in this book appear to relate to compounds of doubtfu purity; for example, the curve given for polyviny alcohol shows bands at about 1740 and 1260 wav numbers which are almost certainly due to a smal amount of residual polyvinyl acetate from which th sample may have been obtained by hydrolysis.

These shortcomings do not, however, destroy th great value of this book as a convenient working manual, and it will certainly become widely known and used, together with others which may soon be published, by all those concerned with experimental work in this field. H. W. THOMPSON.

SYMPOSIUM ON INDIA

Essays in Anthropology

Presented to Rai Bahadur Sarat Chandra Roy. Edited by J. P. Mills, B. S. Guha, K. P. Chattopadhayay, D. N. Majumdar and A. Aiyappan. (Published for the S. C. Roy Commemoration Committee of the Indian Science Congress Association.) Pp. viii+268. (Lucknow: Maxwell Co., n.d.) 12 rupees.

"ESSAYS in Anthropology Presented to Rai Bahadur Sarat Chandra Roy" was published in India in 1942, but one of the limitations imposed by war conditions has been the unconscionable delay and irregularity with which books from India have reached Great Britain, if at all. In this case, Roy's *Festschrift* did leave the press in time for him to read it shortly before he died in April of that year, and it must have given him much gratification, for he must have appreciated the general high level which these essays as a whole maintain, and to which his own work indirectly had done much to contribute.

There are twenty-one essays in all; of these, about a third of them by Europeans, the remainder by Roy's fellow countrymen. Both the physical and sociological sides of anthropology are represented, but the latter greatly predominate, physical anthropology being limited to three papers: Dr. Eileen Macfarlane, writing on "The New Systematics and Anthropology", sums up the present position in regard to the classification of human racial units—a very lucid and useful exposition. Drs. R. Krishna u and A. Ananthanarayana Ayer contribute a udy at length of South Indian brains, and G. M. urulkar studies briefly "The Abdominal Bulge in ealth (Males)".

Turning to the non-physical contributions we find useful essay on "Basic Concepts in Anthropology" y Mandelbaum which has been evoked in part by orrespondence resulting from the broadcasting of ctures in anthropology direct from a Minnesota assroom. Clearly the study of anthropology is ore popular, or better boosted, in the United States an in Great Britain. Aiyappan writes well on Theories of Culture Change and Culture Contact", s does Prof. Chattopadhyay on "Conflict and Social ehaviour", though the latter's psychological explanation of why the inhabitants of Bengal accepted slam more readily than those of the Agra and Oudh nly really amounts to the fact that the latter had een Hinduized for a longer time.

One of the best essays in the volume is Mrs. Karve's "Some Studies in the making of a Culture attern". She examines the conflict between patrineal and patrilocal institutions on one hand and atrilocal institutions on the other, and discusses he cross-cousin marriage in Maharastra, and the aternal uncle-niece marriage found farther south. he comes to the conclusion that patriliny is an ndigenous institution derived from a primitive unting-gathering complex; and although one may ind difficulty in accepting the theory that it was not an Indogermanic import, one cannot but endorse wholeheartedly her criticism of "the unsoundness of a policy which would impose the same code on the whole of India completely disregarding the cultural nd historical antecedents of different provinces and different castes".

All the essays, of course, are not of the same high level. Radhakumud Mookerjee's attempt to show that the Rig-Veda is not later in time than the Indus civilization of 3000 B.C. fails to convince. He argues that the Hittite deities with names analogous to those of India, Mitra and Varuna, must have been carried to Mesopotamia from India, ignoring the more likely hypothesis of a distribution from some common centre in Iran or near the Caspian. He seems to think, moreover, that the Sumerians and "Dravidians" belonged to a common physical type; but whereas the Sumerians, so far as our evidence goes, seem to have been brachycephalic, Dravidian-speaking India is on the whole emphatically dolichocephalic, and his statement that the Rig-Veda "is the earliest text not merely of India but of the world" does not help one to accept his conclusions without reserve.

W. J. Culshaw writes of "The 'Folk Consciousness' of the Santals", and W. G. Archer of "The Women's Hunt", a periodic phenomenon of Oraon culture which impresses itself on neighbouring tribes as a sort of "cross between a pantomime and a carnival". J. P. Mills deals with "Some Recent Contact Problems in the Khasi Hills", making the problems clear enough but not offering a solution; C. Fürer von Haimendorf writes of "Religion and Ethics among the Konyak Nagas and other Indian Tribes" and in doing so qualifies the conclusions he came to in "Custom is King"; and Elwin writes, informatively again, on "Primitive Ideas of Menstruation and the Climacteric in the East Central Provinces of India". P. G. Shah in "Non-Hindu Elements in the Culture of the Bhils of Gujarat" makes a useful and important contribution to the study of that tribe, the documentation of which has been neglected to an extent out of all proportion to its importance.

The remaining essays—though one seeks in vain, alas, for one by Dr. B. S. Guha—include one on "Bongaism" by D. N. Majumdar, a joint editor who contributes also an introduction giving an account of Sarat Chandra Roy, whose portrait serves as a frontispiece, but is not well reproduced. The volume has an index and is commendably free from misprints. "Essays in Anthropology" is probably the first anthropological *Festschrift* to appear in India. If subsequent ones keep up to the standard set by it they will do well enough.

J. H. HUTTON.

FUNCTIONS OF A COMPLEX VARIABLE

Vorlesungen über allgemeine Funktionentheorie und elliptische Funktionen

Von Prof. Adolf Hurwitz. Herausgegeben und ergänzt durch einen Abschnitt über Geometrische Funktionen, von Prof. R. Courant. Dritte, vermehrte und verbesserte Auflage. (Published and distributed in the Public Interest with the consent of the Alien Property Custodian.) Photo-lithoprint Reproduction, 1929. Pp. xii+534. (New York: Interscience Publishers, Inc., 1944.) 7.50 dollars.

PERHAPS one of the most regrettable consequences of the War, from a purely academic point of view, has been the inevitable loss of touch with current developments in Europe and the accompanying inaccessibility of standard Continental literature. The appearance of a photo-lithoprint reproduction, from the United States, of one of the classical treatises on function theory, which in pre-war years was rightly regarded as an indispensable possession of the pure mathematician, is thus an event of paramount interest and importance.

This volume, in German, containing among its pages all the fundamental theorems and the results of the classical theory of functions of a complex variable, is so well written as to be almost impervious to any sort of criticism, however fastidious.

It is a third and enlarged edition of the original produced by the authors in 1922 and is divided into three principal sections, of which the first two are mainly ascribable to Hurwitz and the last to Courant.

The first section consists of a development from 'first principles' of the Weierstrassian treatment of the theory, the fundamental idea being the complex power-series and its analytic continuations, from which Cauchy's theorem and its corollaries are ultimately derived. A certain amount of special function theory is also included, with particular reference to integral and meromorphic functions.

The second section, on elliptic functions, gives an account of the elementary properties of doubly-periodic functions, proceeding by way of the Weierstrassian functions and theta functions to those of Jacobi and the elliptic modular function and finally to a discussion of elliptic integrals and their transformations.

The last half of the book, comprising the third section, is entitled "Geometrical Function Theory" and deals very comprehensively with a large variety of topics, including Riemann surfaces, Picard's theorem, conformal representation, Dirichlet's principle, Green's functions and the fundamental theorem of Riemann.

J. H. PEARCE.

ELECTRON SHADOW-MICROGRAPHS OF HÆMOCYANIN MOLECULES

By Prof. ROBLEY C. WILLIAMS
AND
Dr. RALPH W. G. WYCKOFF
Department of Physics and the Virus Laboratory,
Department of Epidemiology, School of Public Heath,
University of Michigan

ELECTRON micrographs of bacteria[1] and of virus particles[2] covered with an obliquely deposited metallic film have a three-dimensional appearance that brings out clearly the shapes of these objects. The visibility of small objects appearing in these preparations has been so greatly enhanced by the shadowing technique[3] that we have been led to apply it to the photography of the elementary particles, or molecules, of a number of proteins and high polymeric substances. The present communication describes such experiments carried out on a hæmocyanin.

Purified hæmocyanin was prepared by quantity ultracentrifugation from the 'blood' of the horse-shoe crab, *Limulus polyphemus*, which has already been photographed with the electron microscope[4]. This 'blood' was first cleared by centrifugation for an hour in a field of *c.* 5,000 times gravity, all sedimented material being discarded. The resulting clear blue solution was then ultracentrifuged for four hours in a field of slightly more than 100,000 times gravity to sediment much of its hæmocyanin. This produced pellets consisting of a very firm colourless core overlaid by a blue transparent jelly which dispersed readily in distilled water and was taken as crude hæmocyanin. The solution of the jelly, after a second hour of clearing at low speed, was ultracentrifuged again at 100,000 times gravity to yield homogeneous bluish pellets. Their dispersion in distilled water provided the purified hæmocyanin used for electron microscopy.

In a first series of experiments, serial dilutions of this hæmocyanin in distilled water were placed, as micro-drops, on the surface of collodion-covered metal screens prepared in the usual fashion for examination in the electron microscope. After standing for a minute on the screens, as much as possible of each droplet was withdrawn and the rest allowed to dry. These dried preparations were placed in a vacuum chamber designed for the evaporation of metallic films, and covered with an obliquely deposited film of metallic chromium having a computed thickness of *c.* 70 A. The angle of deposition used in studying hæmocyanin was always such as to make the lengths of shadows ten times the heights of the objects casting them.

Fig. 1 was obtained by photography with an RCA type EMB microscope of an appropriately dilute solution of hæmocyanin prepared in this way. The film of hæmocyanin, which was continuous at greater concentrations, here has begun to break up into its spherical components and to leave empty spaces or holes such as that near the centre of the figure. As the shadows within this hole indicate, metal was evaporated downwards from the top of the picture. At still greater dilutions such areas of unoccupied collodion, which can be recognized by their characteristic pebbly structure of very fine grain and by the shadows cast on them by the surrounding hæmocyanin, increase in size and number, and the hæmocyanin film itself becomes more fragmented, breaks up into islands and ultimately separates into its component particles distributed singly and in small aggregates.

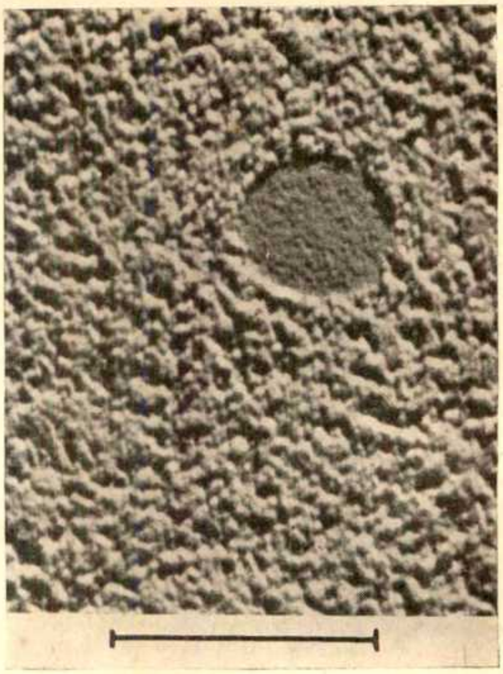

Fig. 1. AN ELECTRON MICROGRAPH OF A DILUTE SOLUTION OF *Limulus* HÆMOCYANIN SHADOWED BY THE OBLIQUE DEPOSITION OF *c.* 70 A. OF METALLIC CHROMIUM.

(Figs. 1, 2 and 3 are negatives; hence regions which appear dark are relatively transparent to electrons. They have each been prepared from the original plates by making an intermediate contact positive on medium lantern-slide emulsion and printing from this on to # 3 Bromide paper. The line at the bottom of each figure represents one micron on the photograph.)

The particles of hæmocyanin are so small that their shapes and dimensions as recorded in such pictures as Fig. 1 must of necessity be considerably altered by the thickness of chromium deposited on their 'illuminated' sides when the angle of shadowing is as great as 10 : 1. In order to give them a truer representation, we have carried out a second set of experiments using gold rather than chromium as the shadowing metal. Gold will deposit as a continuous film when very thin, and because of its great scattering power for electrons will cast adequate shadows in a calculated thickness of only 5–10 A. Fig. 2 is a photograph of a dilute hæmocyanin solution after shadowing with *c.* 8 A. of gold. The hæmocyanin molecules, singly and in small clusters, are clearly evident upon their collodion support.

Though there is no danger of confusing these hæmocyanin molecules with the details of the pebbly collodion background, it is evident that with other smaller macromolecules such a confusion will occur long before one reaches the lower limit of particle size that can be photographed in shadowed preparations. Polished glass has a surface that appears much smoother than collodion, and we have shown[5] that a replica technique can be used to reproduce for lectron micrography both the texture of the glass surface and the size and shape of tobacco mosaic virus protein fibrils deposited on it. A third series of xperiments has been made to see whether or not paricles as small as the hæmocyanin molecules could be investigated successfully with the help of such replicas.

To make these replicas, small drops of dilute hæmocyanin solutions were allowed to dry directly on the cleaned surface of a microscope slide, which was then placed in the vacuum chamber and covered with 6–8 A. of obliquely deposited gold. The areas for study were coated immediately after removal from the chamber with a thin layer (*c.* 500 A.) of collodion. As soon as dry, this collodion and its adhering gold were stripped from the glass and prepared for electron microscopy according to the usual procedures[6] developed for handling metallographic replicas. Because of the great scattering power of the gold compared with organic materials, the replica shows the presence of very small particles regardless of whether or not they are removed from the glass along with the stripped metallic film.

A photograph of such a replica is reproduced as Fig. 3. Comparison between it and Fig. 2 demonstrates that the replica is as successful in showing particles the size of the hæmocyanin molecules as it has been in delineating the tobacco mosaic fibrils. The hæmocyanin molecules appearing in the two figures do not have measurably different sizes and shapes. The background of the replica is more uniform because of the smoothness of the glass surface, and because the fine structure of the unshadowed collodion cannot be seen. Such results suggest that particles much smaller than the molecules of hæmocyanin can be recorded through the use of this replica technique.

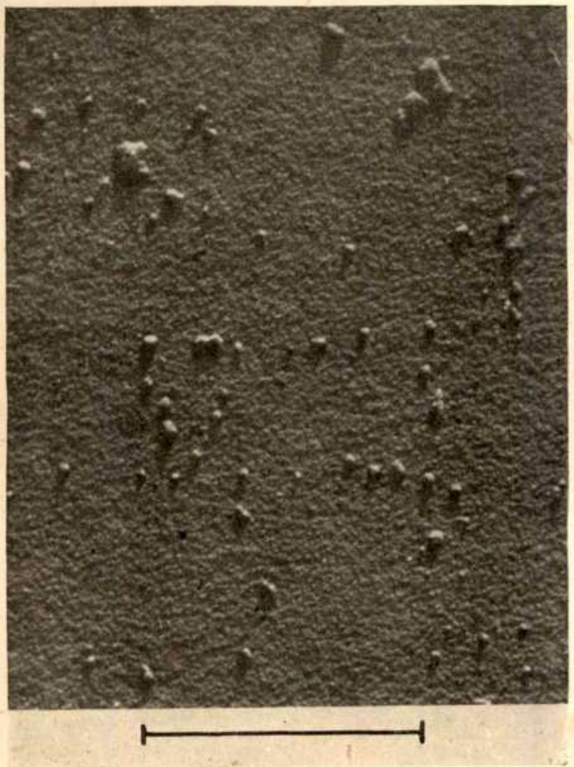

Fig. 2. A MICROGRAPH OF A MORE DILUTE HÆMOCYANIN SOLUTION SHADOWED BY THE OBLIQUE DEPOSITION OF 6–8 A. OF GOLD. RELATIVELY FEW HÆMOCYANIN PARTICLES, MOSTLY IN SMALL CLUSTERS, ARE DISTRIBUTED OVER THE PEBBLY COLLODION SUBSTRATE.

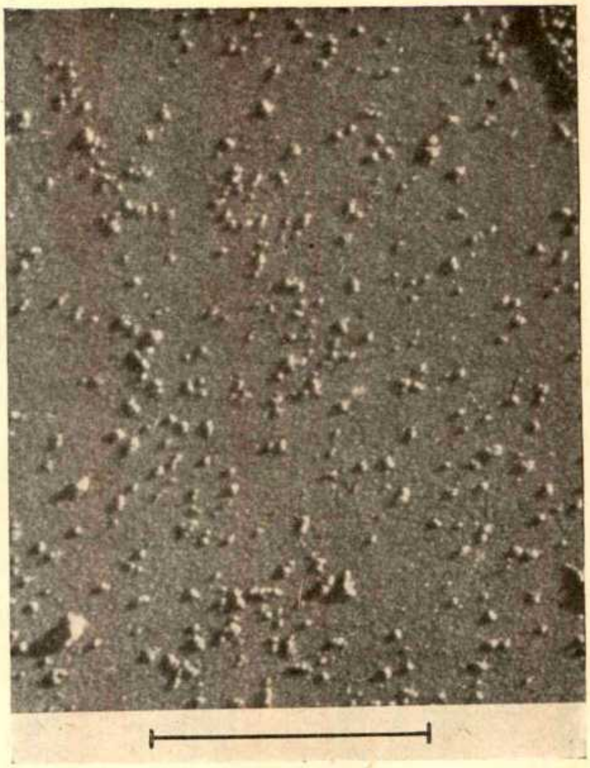

Fig. 3. A MICROGRAPH OF A GOLD REPLICA OF HÆMOCYANIN PARTICLES ON A POLISHED GLASS SUBSTRATE. A PORTION OF A LARGE HÆMOCYANIN CLUMP CAN BE SEEN AT THE TOP RIGHT-HAND CORNER. THE PARTICLES, AS WELL DEFINED AS IN FIG. 2, STAND OUT MORE CLEARLY ON THE SMOOTHER BACKGROUND.

The sizes of the individual particles of Figs. 2 and 3 have been compared with estimates of molecular size derived from rates of sedimentation in the analytical ultracentrifuge. The hæmocyanin from *Limulus* is not so satisfactory for this purpose as some other hæmocyanins would have been, had they been available, because its sedimentation diagram[7] shows evidence of four different particle sizes with sedimentation constants of 57, 35, 16 and 6 *s* units. Spherical molecules of proteins sedimenting at these rates may be expected to have diameters between something less than 100 A. and about 20 A. Diameters have been determined on four hundred particles in one photograph, care being taken to measure only those showing no evidence of clustering. These measurements of diameter were made at right angles to the direction of shadowing, since the size of particles should be little affected in this direction by the deposition of metal. When plotted they give an almost symmetrical Gaussian distribution curve that has its maximum at 165 A. and a width of 80 A. at half-height. Measurements on the unshadowed photographs[4] had led to a particle diameter of *c.* 200 A. We are not now in a position to discuss in detail either this lack of evidence of molecules corresponding to multiple sedimentation boundaries or the large spread in particle-size about its mean value. It seems probable that a factor in causing such a spread is shrinkage suffered during desiccation by these particles which, like most other protein molecules, are strongly hydrated in solution. In this connexion it will be noted that shadow lengths are in general less than ten times the particle-diameters, and that there is consequently a very considerable flattening of the particles considered as spheres.

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SOME FACTORS CONCERNED IN THE PROCESS OF STARCH STORAGE IN THE BARLEY GRAIN

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CARBOHYDRATE synthesis in the barley plant displays two distinct phases, associated respectively with vegetative development and the succeeding period of ear development. The first phase is characterized by the irreversible synthesis of polysaccharides of the cellulose type based on C_6 and C_5 sugar and uronic acid units, which compounds account for 75 per cent of the carbon assimilated before the ear shoots. Starch appears only rarely, locally and in small amounts. The second phase is concerned almost exclusively with starch synthesis, and this substance, accumulated solely in the grain, may constitute 30 per cent of the total dry weight attained and more than half the dry matter of the ear.

The early view that sugar arising from the photosynthetic activity of the leaves was translocated up to the ear and there condensed to starch was superseded early in the present century by the notion that reserve materials were stored, mainly in the stem, during the vegetative stage of growth, and after the ear had shot formed its principal source of carbon. In 1920 Beaven[1] expressed the position as follows: "Some time before the grain is ripe the plant ceases to gain solid matter. Its last effort is to transfer its accumulated reserves into the grain, but all or nearly all the dry matter of the ear is first stored up by the leaves or stems of the plant. . . . It is mainly on the extent to which this uplift takes place that plenty or scarcity of the food of man depends."

The basis of this view was the recognition of the fact, pointed out by Dehérain and Dupont[2] in 1901, that during the period of active starch synthesis, the leaves of cereals were senescent and so unlikely to be capable of producing the requisite sugar by photosynthesis; but it overlooked their suggestion of an alternative assimilating surface together with their demonstration of the assimilating power of the stems. From this conception of migration as a distinct and important physiological process, Beaven termed the ratio of grain to total tops the 'migration ratio' and selected high-yielding varieties on this basis in the belief that high ratios implied efficient migration. Afterwards Engledow and Wadham[3], from thorough studies of the yielding power of cereals, concluded that only the 'migration ratio' appeared to hold any promise as an index of yielding power. There were at that time no adequate chemical data to lend quantitative support to this quite unequivocal hypothesis, but by 1924 Colin[4] and Belval[5] showed that sugar concentration in the cereal stem, chiefly sucrose and fructosan, increased to quite high levels prior to flowering, and afterwards declined as the grain filled These results were considered not only to support the migration theory but also to specify the principa migratory substances as the sugars of the stem; at the same time the notion was stressed that the upward movement was in some way initiated by the demands of the developing ear.

In the last decade two lines of work have led to a reconsideration of the position. Seasonal changes in dry weight of barley and wheat were studied concomitantly with sugar changes by Archbold[6] and Barnell[7,8]. Both groups of data suggested that the amount of sugar stored in the stems was insufficient as almost the sole source of carbohydrate for the ear. In the meantime, Boonstra[9] and Smith[10] had shown, by experiments with shaded wheat ears, that the ear itself is an important assimilating organ, an observation later extended to barley by Watson and Norman[11]. These experiments, besides establishing the assimilating function of the ear, weaken the simple assumption that increase in dry weight of the ear accompanying loss in weight of the stem necessarily denotes upward migration of previously stored material. It now seems likely that the earlier view is correct, and that starch synthesis proceeds simultaneously with the formation of its precursor by photosynthesis, storage of reserves during the vegetative stage of growth playing no essential part. Assimilation for this purpose is not, however, confined to the leaves, but is carried on in turn by all the green surfaces of the plant. A short account of the considerable body of evidence which has now accumulated supporting this view forms the subject of this article.

The first aim of the studies was to establish the part played in the nutrition of the ear by the immediate translocation of newly assimilated carbon and by the upward movement of temporarily stored products, including among the latter nitrogenous compounds. Analysis of some forty-eight samples of plants grown under a variety of manurial treatments established that there were no unidentified sources of possible migratory substances. The whole dry weight of leaves and stems was accounted for in the common groups, sugars, organic acids, proteins, cellulose polysaccharides and so on. Apart from the sugars, the organic acids formed the largest single fraction of the water-soluble material, and although not of importance in the present connexion there is no reason to suppose they are without metabolic significance; indeed, striking responses to manurial deficiencies have been established. A special search was made for sugar combined in forms other than those usually estimated, but only a small amount of 'glycoside' glucose liberated by N acid hydrolysis was found. This occurred mainly in the leaves and showed a downward drift with time, but since the maximum amount present was of the order only of 1 per cent of the dry weight of the mature ear, it can be dismissed as a possible reserve substance. Throughout a long series of experiments no evidence of significant loss of constituents of the water-soluble fraction of the dry weight other than sugar has been found; if anything, this group tends to increase a ttle in the stems rather than decrease as the ear develops. The whole relevant change in dry weight of the vegetative organs is therefore accounted for in terms of the losses of sugar and of the fraction insoluble in water and alcohol, namely, proteins and polysaccharides.

Having delimited the possible sources of supply for he ear to sugars, and to 'cellulose' and protein, it was possible to examine the total dry-weight changes by simply weighing the alcohol/water-insoluble fraction and estimating sugar in the extracting fluids. Proceeding along these lines, it was found by Archbold and Mukerjee[12] that at no time did the roots provide material for upward translocation. Root sugars were always extremely low (maximum 1 per cent of total plant sugar) and there was no evidence of polysaccharide breakdown in these organs. The roots may thus be safely disregarded. Major changes during ear development were therefore confined to the stems and leaves, and in these organs to the cellulose/protein fraction and the soluble sugars, both of which declined continuously from maxima reached at about the time of ear emergence. These losses, measured in four seasons, were equivalent to 8–18 per cent of the dry weight of the mature ear for sugars, and 1–10 per cent for the cellulose/protein groups, with averages of 12·5 per cent and 5 per cent respectively. Part of this latter loss will represent transferred nitrogen, and so is a maximum estimate of possible polysaccharide loss. If it be assumed that the whole of this loss from leaves and stems represents material moved into the ear, the maximum amount which can be supplied in this way is about 20 per cent, leaving at least 80 per cent to be supplied by assimilation proceeding simultaneously with ear growth. It must be concluded that the conception of migration as a distinct and important process initiated by the shooting of the ear is not well founded and that the ear differs in no essential way from the internodes of the stem as regards its development. Primary assimilate from the subtending leaf provides the carbon for the growth of each internode, any excess appearing as sugar; similarly the ear depends largely upon leaf assimilate for its early growth, but later stores the products of its own photosynthetic activity as starch. In spite, therefore, of the high concentrations of sugar reached in the barley stem (5–14 per cent according to nutritional conditions) the absolute amounts are not large relative to total ear weight, and the indications of the earlier experiments are borne out, that the stored sugar is at best only of secondary importance as a source of supply to the ear.

In order to investigate further the factors controlling sugar movement, a second series of experiments (Archbold[13], and Archbold and Datta[14]) was carried out, in which carbohydrate shortage was artificially induced in an attempt to divert to the ear both carbohydrates immediately formed by assimilation and those stored in the stem. For this purpose the three main centres of assimilation, namely, leaves, stems and ears, were in turn put out of action either by removal (leaves) or by shading of the organ (stems and ears). The treatments were carried out on one or more occasions during the four weeks prior to ear emergence, the period of rapid sugar accumulation in the stems, and again at about the time of completion of stem growth, contemporarily with the maximum stem sugar level. Defoliation three weeks or more before ear emergence was followed by an immediate fall in stem sugar, but after about seven days the level rose again slowly to a very much reduced maximum coincident in time with the maximum in control plants. Later defoliation resulted in a continuous fall in stem sugar; this treatment therefore prevents or much restricts accumulation of sugar in the stems, and at the same time stem growth, as measured by increase in the cellulose/protein fraction, is also restricted. Ears nevertheless continued to develop, attaining a final dry weight ranging, in several experiments spread over three seasons, from 0 to 25 per cent less than that of normal plants. Shading the stem two to four weeks before ear emergence resulted in a temporary check in stem sugar accumulation, which was afterwards resumed at the normal rate; stem growth was again restricted and the dry weight of the ear reduced by amounts up to 20 per cent, largely due to a reduced number of grains. Finally, early shading of the ear reduced only slightly the level of sugar in the stems and exerted negligible effects on its growth, while the dry weight of the ear was reduced by 30 per cent. Composition of the leaves was unaffected by either of the shading treatments, so that leaf sugar was not depleted to meet carbohydrate deficiency elsewhere, and accordingly it may be assumed that in these circumstances leaves continue to export the normal amount of sugars, and furthermore, that the leaves are the main source of the sugar normally accumulating in the stems. The time sequence of sugar change remained unaltered, so that the main effect of the checks on sugar accumulation in the stem was to lower the maximum attained; the reduction was large after defoliation, but only small after shading of stems or ears. In the subsequent phase of falling stem sugar the relative rates of sugar loss were either unaltered or slightly lowered in the treated plants, and approximately zero levels were always reached at the same time as in control plants. Depletion of the stem sugar was not therefore accelerated by the induced carbohydrate shortage, the rate of loss being apparently chiefly dependent upon the maxima reached and so upon sugar concentration. This conclusion is supported by the behaviour of earless tillers. If ears are removed during the phase of rising sugar content in the stem, additional accumulation occurs and concentrations up to 18 per cent may be reached. The maximum again coincides in time with that of control plants, and later sugar is lost at rates even greater than that in normal tillers, although no ear is present.

When defoliation and shading treatments were delayed until stem sugar had reached its maximum value, ears had emerged and attained about 40–50 per cent of the final dry-weight and, moreover, active starch synthesis was now in progress. At this stage treatments were without effect on the rate of sugar loss, nor was there any induced breakdown of polysaccharide to supply the ear, while only shading of the ear had large effects upon the ear itself. The reduction in ear dry-weight due to this late defoliation ranged only from 0 to 9 per cent, and due to stem shading was of the order of 5 per cent. The effect of ear shading, however, remained of the order of 30 per cent, equivalent to at least half the total amount of starch, from which it seems that after ear emergence the ear may be altogether autonomous in respect of starch synthesis.

Taken together, this group of experiments indicates that only very limited diversion to the ear of sugar newly assimilated in the leaves is possible, as represented by the slightly reduced maxima attained in the stems after early shading of stems or ears; there is no evidence of diversion of previously stored sugar, or of induced polysaccharide breakdown in response to the carbohydrate shortage supposedly arising as a result of treatment. The sugar accumulating in the stems is shown by the defoliation and stem shading experiments to originate in the leaves; but the presence of excess sugar is not in itself sufficient to ensure continued growth, since accumulation proceeds in plants with shaded stems or ears accompanied by restriction of ear growth and in the former case of stem growth as well. Only after early defoliation did there appear to be a condition of true carbohydrate shortage. The complex mechanisms controlling starch and cellulose synthesis do not therefore respond directly to the supply of carbohydrate but require that the plant shall be intact and in the light, and it seems that under normal environmental conditions, as well as those imposed in these experiments, sugar accumulation results from over-production in relation to the capacity of these mechanisms rather than as a necessary reserve substance. The accumulated sugar is not, however, in a static condition, and the levels are presumably only maintained by a process of continuous replacement, since arresting the supply of fresh assimilate either by defoliation or by exclusion of carbon dioxide from the surrounding atmosphere leads to an immediate fall in sugar-level.

The absence of effect upon stem sugar losses, when assimilation was partially prevented at the time of maximum stem sugar, is particularly striking and suggests that the role of stored sugar as a reserve for the ear is very questionable. It has been shown that this sugar cannot form a large part of the carbon supply to the ear, and the continued development of ears in defoliated plants, where this store of sugar is virtually absent, shows that it is not essential to later stages of ear growth. Finally, the high rate of loss of sugar from stems deprived of ears shows that the ear is not concerned in the control of this process. The question then arises as to whether in fact this stem sugar is not lost as part of the normal senescent drift of the stem itself rather than by upward translocation to the ear. The distribution of sugar between the several internodes lends some weight to this view. Each internode appears to behave as an independent unit, depending for its sugar supply upon the attached leaf, a fall in sugar ensuing when the leaf is no longer functional, and moreover the evidence suggests that there is no rapid interchange between one internode and another.

It is recognized that conclusive evidence of the precise fate of sugar in the cereal stem is not yet forthcoming, and the view that it is not lost by upward translocation requires substantiation. Alternative possibilities would appear to be conversion *in situ* to other compounds or loss as carbon dioxide. At present the former possibility is quite unexplored, but a start has been made in the study of the respiration of the stem. Carbon dioxide output during the hours of darkness and at prevailing night temperatures has been measured for whole tillers, and for defoliated and earless stems, during the phase of falling stem sugar. On the assumption that sugar loss is continuous throughout the twenty-four hours the average rate of loss (0·35 mgm. per gm. dry weight per hour) in whole tillers showed good agreement with the respiration rate (0·32 mgm. per gn dry weight per hour, calculated as hexose) observe for the dark hours. If, therefore, the day-tim respiration is of the same order as that at night an the carbon dioxide reassimilated during the da appears in a form in which it can be synthesized t starch, it might be concluded that all the sugar los is accounted for by oxidation to carbon dioxide However, the agreement for the stems alone was les good, and here the rate of sugar loss (0·45 mgm. pe gm. dry weight per hour) was apparently higher tha the equivalent carbon dioxide output (0·25 mgm. pe gm. dry weight per hour). Moreover, not only ar essential respiration requirements met in defoliate stems with very low sugar contents; but also in stem of nitrogen-deficient plants, where respiration rate i presumably low, rate of sugar loss is high owing tc the high sugar-levels induced by this deficiency More data are therefore required before a definitive estimate of the proportion of stem sugar lost in respiration can be made, and it can only be suggested that perhaps half the sugar may be accounted for in this way.

Failure to induce sugar movement by partial prevention of assimilation, together with the clear indication that in plants with shaded stems or ears factors other than carbohydrate deficiency were operative in controlling sugar utilization, led to an attempt by Archbold and Datta[15] to influence sugar movement by exploiting the known effects of nitrogen deficiency on sugar content. Nitrate was supplied to the plant at the time when sugar was accumulating rapidly in the stem and also at the time of the sugar maximum. On both occasions uptake was rapid for about a fortnight and the nitrogen content of tillers already present was more than doubled, while at the same time new tillers arose. The plants developed the deep blue-green colour characteristic of high nitrogen status and remained green for some time longer than controls. Active reduction of nitrate took place immediately and at first the additional nitrogen was found distributed between all the organs, about 30 per cent going to the leaves and 40 per cent to the stems after the earlier of the two applications, but by harvest all had been transferred to the ears. Concurrently with this rapid nitrogen uptake, sugar accumulation in the stems was restricted, presumably by preferential utilization of the leaf assimilate for union with the reduced nitrate. There followed a slow rise of stem sugar to a lower maximum than in the control plants, and still later a slow rate of loss in the senescent phase of the stem. This course of sugar change differs from that found after early defoliation only in that the restriction of the sugar accumulation is not so great. When the addition of nitrate was delayed until sugar was maximal in the stem, the onset of sugar loss was actually also delayed, although 80 per cent of the nitrogen taken up appeared at once in the stems and ears. At this stage, therefore, addition of nitrate prolonged the time during which the stems remained green and at the same time maintained a high sugar-level, again indicating that sugar loss from the stem is associated with senescence rather than with ear growth. At both stages, synthesis of nitrogenous compounds was apparently effected at the expense of newly assimilated carbon.

Preliminary attempts to determine whether such new assimilate was essential for elaboration of the nitrogen have only served to stress the complexity of the problem. By supplying nitrate to detached llers in the light either in air or in a carbon dioxide-ee atmosphere it was found that sugar loss was ccelerated in the presence of the added nitrogen, hether or not carbon dioxide was excluded. The dditional sugar loss, however, bore no obvious elation to the amount of nitrate reduced, and indeed n one case, where the initial nitrogen level of the ample was high, no reduction of the nitrate taken p could be observed, although the high rate of sugar oss still occurred. Nevertheless, the experiments with dded nitrogen fall into line with those dealing with arbohydrate shortage in that accumulation of stem ugar in intact plants was inhibited by the treatment, ut rate of sugar loss was not accelerated. Numerous well-known experiments with detached leaves have hown that stable sugars can be taken up and converted to starch, or lead to production of nitrogenous compounds when supplied along with a suitable source of nitrogen. The failure of the barley plant to utilize stored sugar in this way may therefore be due o the location of the sugar rather than its chemical form, and the preferential use of primary assimilate arise from the ease with which it can be brought into association with the appropriate enzyme mechanisms. At present it is not known whether the starch-forming enzymes occur exclusively in the grain, but in the meantime formulation of schemes whereby fructosans or pentosans might be converted to starch appear superfluous, since evidence of upward translocation of the former is lacking, and the evidence points to an irreversible synthesis of the polysaccharides from which the latter might be derived. Rather a single starch precursor may be postulated largely produced *in situ* in the ears and possibly identical with the translocatory substance (sugar ?).

Since the carbon used for ear development and especially for starch synthesis derives principally, if not entirely, from current assimilation, the available evidence regarding the functional importance of the several plant organs in this respect may be summarized. From a number of defoliation experiments it is estimated that, after ear emergence, the leaves supply not more than 10 per cent of the final dry weight of the ear compared with a contribution of 30 per cent by the ears themselves. Before ear emergence the leaves may contribute a further 15 per cent, mainly leading to polysaccharide and protein synthesis. There remains the rather large amount of 45 per cent attributable by difference to stems and sheaths, of which somewhat less than half is contributed before emergence of the ear. Attempts to confirm this estimate by experiments in which stems were shaded or in which only stems were left exposed to light led to conflicting results owing to the different effects of treatment other than the prevention of assimilation. Shading the stem at the time of ear emergence had little effect on the final dry weight of the ear, indicating a small assimilatory capacity at this stage, a view supported by the failure of stems deprived of ears and leaves to accumulate sugar as compared with those from which only ears were removed. When stems alone were left exposed to light, however, a higher estimate of the apparent assimilatory capacity was obtained. As a rough approximation perhaps half the material of the ear accumulated before emergence may be attributed to activity of the leaves and half to the stems and sheaths, of which latter half a large proportion is probably derived from the flag leaf-sheath[13]. The rapid senescence of the leaves after ear emergence suggests that the estimate of 10 per cent or less for their contribution during the period of active starch synthesis is probably correct, leaving the mode of division of the remaining 40 per cent as between stems and ears uncertain. The data thus confirm the view that leaves are relatively unimportant as regards starch synthesis, and make their essential contribution in the period before ear emergence. If the discrepancy between the estimates of the stem contribution is in part due to under-estimation of the contribution of the ear itself, this organ may prove to be almost wholly responsible for the immediate starch precursor.

The experiments summarized here, dealing with the sugars of the barley plant, cast doubt upon the hypothesis that the stored sugar of the stem is a reserve for maintaining the growth and development of the fruit. If the alternative view be accepted that this sugar is lost as part of the inevitable senescence of the stem itself, then the function of accumulations of sugar not only in other monocotyledonous stems, for example, the sugar cane, but also of other types of storage organ may need reconsideration in this light. In storage roots such as carrot or sugar beet it is well known that the separated crown can produce a flowering stem though deprived of the bulk of the stored carbohydrate; similarly, in tubers such as artichoke and potato, the so-called reserves of inulin and starch are not essential to successful regeneration. Thus, while it is manifest that some part of the 'carbon' of the storage organs must undergo metabolic changes leading to shoot formation, the amount involved is probably small in relation to the total carbohydrate reserve, and the same general interpretation is possible for these types of sugar accumulation as for the barley stem; namely, that sugar is produced in excess of immediate growth requirements and becomes isolated in parenchymatous tissue, from which it disappears slowly with the senescence of the 'storage' organ. These two types of sugar storage would then fall into line, as regards absence of essential function in subsequent growth, with the sugar of the fleshy fruits, which cannot be regarded as a substrate for future growth. The resulting unification of the conceptions of the status of these three types of sugar accumulation emphasizes the view that sugar concentration of itself plays no part in initiating plant syntheses, but rather that stable sugar arises when assimilatory capacity is in excess of that for utilization. The necessity for a better understanding of the factors, of which nitrogen supply is of first importance, controlling sugar utilization is obvious.

If any function is to be attributed to the sugar in such organs as the shooting stem of the cereal it may perhaps be concerned with maintenance of turgor in the rapidly elongating cells, but this is frankly speculative, and at present without experimental verification.

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OBITUARIES

Prof. Leif Tronstad, O.B.E.

The death of L. H. L. Tronstad on active service in Norway, while leading a daring operation in March 1945, has deprived his country of one of its most outstanding men of science, and his collaborators in all parts of the world of a valued friend.

Leif Hans Larsen Tronstad was born in 1903 at Baerum, near Oslo; his father, a farmer, died the same year. He studied chemistry in the Oslo Technical School and the Norwegian Technical University at Trondheim, obtaining brilliant successes despite the fact that he was at the same time working as a teacher and in support of his widowed mother and sister. His first important research was carried out at Berlin, during 1928–29, in Prof. Freundlich's laboratory. A qualitative method of detecting thin oxide films on metals, based on changes in the ellipticity of polarized light, had already been worked out by Freundlich, Patscheke and Zocher. Tronstad succeeded in developing the method to give quantitative measurements of thickness, and showed that, when iron was made passive by anodic treatment, the film thickness increased, while during cathodic activation the thickness diminished. This work not only supplied valuable information as to the causes of passivity, but also suggested a new method of ascertaining the thickness of invisible films, and the nature of the film substance.

After further work on films resulting from electrochemical treatment, carried out in Prof. Benedick's laboratory at the Metallografiska Institutet, Stockholm, for which he received his doctorate at Trondheim, Tronstad proceeded in 1931 to the University of Cambridge. There he improved the method further, testing its accuracy by the study of monolayers of fatty acids, the thickness of which could be measured in other ways; part of this work was carried out in collaboration with C. G. V. Feachem.

Later Tronstad returned to Norway and was elected in 1934 to a temporary professorship in technical inorganic chemistry at the Norges Tekniske Högskole; this chair was made permanent in 1936. He was one of the youngest professors in the country, popular alike with students and colleagues, and enjoyed the reputation of being a first-class teacher. At this stage he was joined by A. B. Winterbottom, and the polarized light method of studying films on metals was developed further. Although not well known to-day, its value is likely to become increasingly appreciated as time passes, especially as it can be employed for just that range of thickness where alternative methods are least useful. Moreover, the method can be used for the continuous study of a film *in situ* during its growth in almost any environment.

Tronstad's interests were by no means confined to the study of films. He played a leading part in the organization of the Rjukan hydrogen plant of Norsk Hydro, for the large-scale separation of heavy water, large quantities of which were supplied for scientific research in Great Britain. Determinations of the physical constants of several deuterium derivatives were made by Tronstad and his associates at Trondheim and Rjukan. Tronstad's electrochemical knowledge was of the greatest value to the Norwegian industries, especially those connected with steel, ferro-alloys, nitrogen, refractories and aluminium; he also carried out researches on the effect of minor elements on the corrosion of aluminium and iro
His published scientific papers number about sixt

Tronstad was greatly attached to Great Britai
where he had many friends. His modesty, sincer
and cheerful good-humour were appreciated by
who met him. He had numerous interests outsi
science; for example, he was a fine athlete, being
his student days a member of the relay team whic
set up a Norwegian record for the 4 × 400 metr
distance; he was also a lover of natural beauty, a
took pride in Norwegian country folk and customs.

During the War, Tronstad was engaged in dari
and dangerous work for his country, which led, on t
eve of victory, to his death in action. Details of h
many-sided war activities must not be given; b
it may perhaps be stated that the results achieve
which demanded the highest courage, organiz
capacity and scientific skill, contributed directly
the speedy victory of the Allied Nations, besid
saving the region which came to be known as 'Souther
England' from an even longer and more severe orde
than it actually endured. He received the Order
the British Empire for his outstanding services.

We would like to thank Mr. A. B. Winterbotto
and Capt. J. H. Reimers, as well as the Roy
Norwegian Government Information Office, for kin
assistance on many points.

E. K. Rideal.
U. R. Evans.

Don Ignacio Bolivar y Urrutia

With the death in Mexico on November 20, 1944 of Don Ignacio Bolivar y Urrutia, the world ha
lost one of the most eminent Spanish naturalists of
generation belonging as much to the last century a
to the present. Ignacio Bolivar was born on November 9, 1850, a member of a noble and ancient family. Although interested from an early age in natural history, young Bolivar had to take up law studies, since his parents hoped that these would provide him with a better livelihood; but he took a degree in natural sciences as well. Before he was twenty, Bolivar became an ardent member of a small but very active group of young Madrid entomologists, and spent much of his free time in exploring the Spanish fauna.

When the Sociedad Espanola de Historia Natural was founded in 1871, Bolivar became its vice-secretary, and in 1872 his first scientific paper was published by the Society. In 1875 he joined the staff of the Madrid Natural History Museum as an assistant in the Zoology Department, specializing in entomology. The whole subsequent career of Bolivar was passed in the Museum, of which he eventually became director, and which grew from a small establishment to an imposing scientific institution and a centre of research. In 1877, Bolivar was also appointed to a chair in the University of Madrid, where he continued lecturing in zoology until 1922, and his combined work in the Museum and the University served to make him one of the leading naturalists in Spain and a teacher of more than one generation of Spanish biologists.

Although primarily a taxonomist himself, Bolivar was always a champion of the study of living organisms, and it was due to his efforts that a marine biological station was established in Santander, while the Estacion Alpina de Biologia in Sierra de Guadarrama, also founded by him, was a somewhat unique ntre where Spanish and foreign biologists were able find modest accommodation and good laboratory cilities amidst unspoilt Nature. This long and utful activity was rudely interrupted when at the e of ninety Bolivar became an exile, followed by a oup of his colleagues. It was characteristic of nacio Bolivar and his younger followers that in exico they should take a most active part in the ientific life of the country of their adoption, and are ntributing greatly to its scientific exploration. A onthly journal, *Ciencia*, launched by them, rapidly ecame a widely known medium of biological knowdge in Latin America.

Although Bolivar published some papers on the emiptera, on other insect orders and on Crustacea, e specialized from his earliest days on the systematics f the Orthoptera, a group particularly well epresented on the Iberian peninsula, where it inludes a high proportion of endemic genera and pecies. The total number of papers published by olivar was about two hundred and thirty, and he escribed more than two hundred new genera and bout a thousand species of Orthoptera. His work on his order partly coincided in time with that of runner, Saussure, Pictet and Redtenbacher, and he s to be included with them as a creator of the modern ystem of Orthoptera.

While a great deal of Bolivar's work was purely lescriptive, we owe to him also a series of revisions nd monographs, and his works on the Tetrigidæ, Pamphaginæ, Pyrgomorphinæ, Truxalinæ and Ephippigerinæ, still remain indispensable for a taxonomist. From the faunistic point of view his main contribution was, of course, to the study of the Iberian fauna, but he ranged widely in his work, from India to the Seychelles and from the Congo, Angola and Spanish Guinea to South America.

Most present-day orthopterists regard Ignacio Bolivar as their master and it was a great and touching occasion when in 1935, during the Sixth International Entomological Congress at Madrid, a group of some fifteen orthopterists of various nationalities gathered round him for a 'family' celebration. For those who knew Don Ignacio personally, it was impossible not to fall under the spell of his vital personality, full of noble and simple charm. His energy was prodigious, and I shall never forget an excursion to the highest peak of Sierra de Guadarrama, when Don Ignacio, then well over seventy years old, led the way on foot for several hours.

The value of Bolivar's work was recognized by the Entomological Societies of London, Belgium and Prague, which elected him honorary fellow, while the Zoological Society of London included him among its twenty-five foreign members. Among many other academic distinctions, he was a doctor *honoris causa* of the University of Pittsburgh. B. P. UVAROV.

Dr. G. C. Robson

GUY COLBORN ROBSON, whose death occurred on May 17, 1945, after a long illness, was born at South Woodford, Essex, on February 11, 1888. He obtained a Classical Scholarship at New College, Oxford, where he entered into residence in 1906. He took Classical Moderations, and then changed over to science, reading for honours in zoology, in which he obtained a first class, and afterwards spent a year in Naples, where he studied the fat-metabolism of crabs infested with *Sacculina*. He joined the staff of the British Museum Natural History in 1913 and was put to work on the Mollusca under Edgar Smith. He became a well-known authority on this group and devoted much attention to their anatomy, as well as the 'conchology' on which earlier classifications were mainly based. He published numerous papers, mainly on the Cephalopoda, including perhaps his most important work, a monograph on the Octopoda, published by the British Museum in two volumes (1929 and 1932). He also studied the biology of *Paludestrina jenkinsi*, a parthenogenetic freshwater snail introduced into Britain some time during the eighties of last century, and now widely distributed throughout Britain.

Robson was attracted to zoology from the philosophical side and it is doubtful whether he was entirely happy in his museum life. His intellectual interests were many and varied—artistic, literary, sociological, philosophical. The latter bent is best shown in his two books, "The Species Problem" (1928) and (jointly with O. W. Richards) "The Variation of Animals and Plants in Nature" (1936). His artistic gifts are evident in the illustrations to his papers and also in his water-colours.

During the War of 1914–18, he served first with the Red Cross and then with the Royal Garrison Artillery and was attached to a coast defence unit. He was bombed during an air attack, and, after spending a year in hospital suffering from shell-shock, was invalided out of the service. He returned to the British Museum, where he spent some of the most productive years of his life and became a deputy keeper. Unfortunately, he never seemed to have recovered fully from his illness, and in 1935 had another nervous breakdown necessitating his resignation from the Museum. He spent the last few years of his life in retirement. E. HINDLE.

Some Czechoslovak Men of Science

NEWS has just reached London that several more Czechoslovak professors, displaced when the Germans closed the universities of that country in 1939, have died in concentration camps. They include Prof. V. Dolejšek, Prof. F. Ulrich and Prof. J. Štorkán. Prof. F. Slavík, a mineralogist well known in Britain and now sixty-nine years old, was rescued from Buchenwald by the Allies just in time, and has now been able to travel to Prague. The fate of Prof. F. Záviška, the physicist, is unknown; he has not yet been traced.

It is now known that Prof. A. Šimek, whose death has already been referred to in *Nature* (**152**, 69; 1943), was executed at Mauthausen concentration camp.

Prof. Dolejšek was a distinguished physicist who worked for a time with Prof. Manne Siegbahn in Uppsala. Some of his work on X-ray spectra was first published in *Nature*, and he is perhaps best known for his discovery of the N-series of X-ray lines. He died at the Terezín camp in January last.

Prof. F. Ulrich had carried out many mineralogical investigations of considerable local interest and had made important petrographic and geological studies. He was also the author of several authoritative treatises on geology and had been elected honorary foreign member of numerous European scientific societies.

Prof. Štorkán had a distinguished career as a zoologist and was an authority on the Central European fauna. He was only fifty-four at the time of his death. G. DRUCE.

NEWS and VIEWS

Prof. G. H. Hardy, F.R.S.

THE appointment earlier this year of Prof. L. J. Mordell to the Sadleirian chair of pure mathematics in the University of Cambridge is a reminder that Prof. G. H. Hardy retired from the Sadleirian chair so long ago as 1942. Throughout his long career as lecturer at Trinity College, Cambridge, during 1906–19, as Savilian professor of geometry at Oxford during 1919–31, and as Sadleirian professor of pure mathematics at Cambridge from 1931 until his retirement in 1942, Prof. Hardy has been a leader of mathematical thought. Forty years ago, mathematical analysis was neglected in England. To-day the English school of analysts commands respect and admiration throughout the world. This development is due almost entirely to Hardy, by the direct inspiration of his own teaching and personality, and through the medium of successive generations of his pupils. An important part was played, particularly in the early stages, by his stimulating book "A Course of Pure Mathematics", first published in 1908 and now in its ninth edition. But it is not possible in this short note to attempt any proper appreciation of the great volume of Hardy's original work, or to recount the imposing list of his collaborators. Chief among these is his former pupil, J. E. Littlewood, who has been a constant partner since about 1912.

The headings under which Hardy's work may be broadly classified (theory of series, theory of functions, Diophantine approximation, inequalities, analytical theory of numbers, Fourier analysis) are closely related, and many of the interrelations can be traced to Hardy's own influence. Thus the impressive body of "Tauberian" theory, with which Hardy and his followers have enriched the theory of series, finds some of its principal motives and applications in the theory of numbers. Again, the researches of Hardy and Littlewood on Diophantine approximation involved a profound study of certain power series near the circle of convergence, and this was no doubt the germ of the famous Hardy-Littlewood-Ramanujan analytical method in the additive theory of numbers, one of the greatest and most fruitful mathematical discoveries of this century. The name Ramanujan recalls what Hardy has described as the one romantic incident in his life—his association with the self-taught Indian mathematician who was to achieve world-wide fame under his guidance. This fascinating story has been told by Hardy himself. It is mentioned here as an example of what Hardy's pupils, one and all, owe to him, perhaps in more orthodox and more prosaic circumstances, in personal interest and sympathetic encouragement of their early efforts—a debt more fully appreciated in later life with the coming of mathematical independence and maturity.

Many honours have been conferred upon Hardy. He became a fellow of the Royal Society in 1910, and was awarded a Royal Medal in 1920 and the Sylvester Medal in 1940. In 1933 he received the Chauvenet Prize of the American Mathematical Association. For forty years he has been a tower of strength to the London Mathematical Society as member of its council, as secretary, and as president. He was awarded the de Morgan Medal of the Society in 1929. Hardy is the author or joint author of several books, all written in the vivid style familiar to readers of his original papers. "A Mathematician's Apology", published in 1940, was received with enthusiasm by th wider public to which it was addressed. Hardy technical writings, as well as his provocative pr nouncements on philosophy and pedagogy, are ofte enlivened by apt illustrations from cricket or othe games, sometimes to the bewilderment of foreig readers.

Anthropology in the University of London: Prof. C. Daryll Ford

THE provision for the study and teaching anthropology in London is being strengthened by th revival of the department in University College whic has been partly suspended during the War. Pro C. Daryll Forde has been appointed to the chair, an he will take up his duties at the opening of the ne session. Prof. Forde first went to University College i 1919, and was there, as student and later as a junio member of staff, until 1928. He worked under Prof Lyde and Elliot Smith in the period in which th latter gave so strong a stimulus to anthropologica studies by the development of his theories on th diffusion of culture. From there he went, with Commonwealth fellowship, to California, and spen two years on studies of the Pueblo Amerindians o the south-western United States and norther Mexico. In 1930 he was appointed Gregynog professor of geography and anthropology in the University of Wales, at University College, Aberystwyth.

After the publication of the results of his fieldwork in America, Prof. Forde became interested in Africa. He has carried out field work in West Africa, where he was caught by the outbreak of war in 1939. Since then he has served in the Foreign Office Research Department, as a member of the Nuffield colonial research team, and for the past year as director of the International African Institute. He has published many papers, and his book "Habitat, Economy and Society" is a well-known exposition of work done in the study of primitive societies. These, and a forthcoming book on native economies in Nigeria, indicate his range of work. He is essentially a field anthropologist, holding that such study of simpler societies can lead to a real understanding of the more primitive peoples, and contribute towards a better knowledge of more complex human societies, such as our own.

Marine Biological Association Laboratory, Plymouth: Mr. F. S. Russell, D.S.C., D.F.C., F.R.S.

THE Council of the Marine Biological Association has appointed Mr. F. S. Russell to be director of the Association's Laboratory at Plymouth in succession to the late Dr. Stanley Kemp. Mr. Russell has been a member of the staff of the Association since 1921 and has played a very important part in the work of the Plymouth Laboratory. His work has thrown much light on the factors which control the distribution of planktonic organisms, and on the relationship of these organisms to more strictly fishery problems. Mr. Russell is at present serving in the Royal Air Force and holds the rank of wing commander.

Mrs. Seán T. O'Kelly

MRS. SEÁN T. O'KELLY, wife of the newly elected president of Ireland, is well known as Miss Phyllis Ryan, public analyst, in Dublin. She studied chemistry under the late Prof. Hugh Ryan at University College, Dublin, graduating in 1916, and obtaining e M.Sc. degree by research in 1917. She collaborated th Prof. Ryan in a number of investigations, in- iding one on the action of nitrous and nitric acids diphenylamine carried out with the co-operation Nobels, Ltd. Later, she set up practice as a con- lting chemist in Dublin, and became public analyst r twelve Irish county councils. In this connexion, is of interest to note that all the members of her boratory staff are women graduate chemists. She s concerned herself vigorously with the organization the chemical profession in Ireland and is a past esident of the Irish Chemical Association. Her new here of activity will, unfortunately, prevent her om continuing to take an active part in the work her profession.

ducational Director of the British Council : Dr. A. E. Morgan

Dr. A. E. Morgan has been appointed educational irector of the British Council and will take up his uties early next month. The post was formerly eld by Prof. B. Ifor Evans, who resigned it on ppointment as principal of Queen Mary College bout a year ago but has continued to assist the ouncil in an advisory capacity. Dr. Morgan, a ative of Bristol, was educated at the then Univer- ty College there, and at Trinity College, Dublin. Ie became lecturer in, and then professor of, English anguage and literature in the University College, xeter, and later occupied a similar chair in the niversity of Sheffield. In 1926 he was appointed rincipal of University College, Hull; and during 1935–37 he was principal and vice-chancellor of McGill University, Montreal. Dr. Morgan became hief special officer for national service, Ministry of Labour, in 1939, and was thereafter a district commissioner for the Special Areas (Durham and Tyneside), and regional information officer at Newcastle-on-Tyne. Since 1941, he has been assistant secretary, Ministry of Labour. The period for which Mr. H. Orton, the acting educational director of the British Council, was seconded to the Council from the University of Sheffield ends on August 31, and he will then resume his duties as head of the Department of English Language at Sheffield.

The R. W. Paul Instrument Fund

The R. W. Paul Instrument Fund was established by a trust created under the will of Mr. R. W. Paul, who died in March 1943. The income from the fund will be administered by a committee composed of representatives of the Royal Society, the Physical Society, the Institute of Physics and the Institution of Electrical Engineers. The committee will consider and adjudicate upon applications which may be submitted for financial assistance by means of grants for the following purposes : (*a*) for the design, construction and maintenance of novel and improved types of physical instruments and apparatus for investigations in pure and applied physical science, particularly in cases where a relatively large expenditure may be justified on experimental apparatus. (*b*) For the assistance of research by provision of equipment, building facilities or financial or other aid in such manner as the committee may determine in each case. Grants from the fund shall not be used to relieve expenditure in any establishment controlled by the Government, or to relieve any university or other educational establishment of its normal financial obligations. When an application is favourably regarded by the committee, an assessor will be appointed to advise in detail on the merits of the application, the feasibility of producing the desired result by means of the proposed instrument or apparatus, the urgency of the need for it and the probable cost of execution of the work.

After a grant has been made, the assessor will report to the committee not less than once every three months on the progress of the work. He may in his discretion recommend additional grants for running and maintenance costs and salaries for the time being of investigators and assistants engaged in a particular investigation, provided that no research fellowship or research scholarship is thus created. The committee will decide the ultimate destination and ownership of all instruments and apparatus produced by means of grants from the fund. Any invention or improvement in existing inventions made by a grantee must be communicated forthwith to the committee, and no grantee may apply for, or obtain, patent rights for such invention without the previous sanction in writing of the committee. Applications may be submitted by any worker or group of workers in Great Britain. Applicants must be British subjects and their qualification in physical research must be supported by the signed recommendations of not less than two of the following persons : (i) president of the Royal Society (if a physicist), or alternatively, the secretary of the Royal Society dealing with physical subjects ; (ii) president of the Physical Society ; (iii) president of the Institute of Physics ; (iv) president of the Institution of Electrical Engineers. Applications should be addressed to the Assistant Secretary of the Royal Society, Burlington House, London, W.1.

Industrial Research Committee of the Federation of British Industries

At a recent meeting of the Grand Council of the Federation of British Industries, it was announced that Mr. B. J. A. Bard has been appointed head of the F.B.I. Research Secretariat and secretary of the F.B.I. Industrial Research Committee. Mr. Bard carried out fuel research under the late Prof. W. A. Bone in the Chemical Technology Department of the Imperial College of Science and Technology, and then read for the Bar ; he practised at the Bar until the outbreak of war, after which he worked first with the Coal Commission and, later, on various industrial production and research problems at the Ministries of Supply and Aircraft Production. The duties and functions of the research secretariat will include the encouragement and fostering of industrial and national interest in research, maintaining contact with all industrial research organizations, and providing a service whereby advice, assistance and information can be obtained and contacts made. Close touch is being maintained with the Department of Scientific and Industrial Research, which is represented on the F.B.I. Industrial Research Committee. A first task will be the organization of a survey of existing research facilities in Britain. Another immediate plan of the Industrial Research Committee is a proposal for a two-day conference, to be held in London in the autumn, of those who are organizing or conducting research in industry, in order that they may present their views and give the results of their experience to industry.

The Industrial Research Committee of the Federation of British Industries is constituted as follows : Sir William Larke (*chairman*), Dr. S. B. Bagley, Sir

Peter Bennett, Mr. W. Bond, Mr. O. F. Brown, Dr. W. T. K. Braunholtz, Dr. P. Dunsheath, Mr. T. A. Fairclough, Dr. W. H. Glover, Dr. W. T. Griffiths, Mr. A. L. Hetherington, Lord Melchett, Mr. R. O'F. Oakley, Dr. C. C. Paterson, Sir Robert Pickard, Mr. R. K. Sanders, Dr. R. E. Slade, Sir Frank Smith, Mr. S. K. Thornley, Mr. B. J. A. Bard (secretary to the Committee and head of the F.B.I. Industrial Research Secretariat).

International Collaboration

THE publication as a "Penguin Special" (price 9*d.*) of E. R. Stettinius' "Lend-Lease: Weapon for Victory" shortly after its original publication as a substantial work of 358 pages (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) is a real service to Anglo-American understanding. Intended originally to facilitate the understanding in the United States of the Lend-Lease Act, it should contribute equally in Britain to the same end. This is important, because, if the new lend-lease agreement with the United States announced in November by the Prime Minister is to be fully understood, it must be remembered that the Lend-Lease Act is for the defence of the United States, and is strictly limited to what is necessary for the effective prosecution of the War by the United States and its Allies. The picture which Mr. Stettinius here paints of the way in which Lend-Lease developed and of the magnitude of the contribution which has been made to victory in Europe in this way is most impressive in its demonstration of the possibilities of collaboration between the United Nations and of the advantages which all might reap from the pooling of economic resources in facing the tasks and problems of peace. At a time when the organization of world order is receiving close attention, it is well that there should be made so widely available such an admirable account of one great experiment in international collaboration which has played a large part in bringing the war in Europe to a successful conclusion. The principle of mutual aid embodied in the Lend-Lease Act and agreements will not come to an end when the war with Japan ends: to it we must also look for the strength to build a world in which freedom and opportunity are secure for all.

British Grassland Society

AT the Fourth International Grassland Congress held in Great Britain in 1937, a group of grassland specialists met to consider the advisability of forming a society in the United Kingdom to promote the study of grassland husbandry. The outbreak of war prevented further progress with the scheme, but in November 1944 a group interested in grassland research met to discuss the foundation of a British Grassland Society, the activities of which would be field tours, discussions and the publication of a journal. The Society was formed early in 1945 and the first meeting was held at Stratford-on-Avon during June 20–22. About one hundred and fifty members attended. At the opening general meeting the following committee and officers were elected for 1945: *President*, Sir R. George Stapledon; *Vice-President*, Dr. Wm. Davies; *Committee*, J. H. Faulder, H. J. Gill, W. D. Hay, F. R. Horne, Prof. T. J. Jenkin, M. G. Jones, Prof. S. J. Watson; *Secretary*, Dr. R. O. Whyte; *Treasurer*, P. A. Linehan; *Editor*, Dr. H. I. Moore. The office of the Secretary is at the Agricultural Research Building, Aberystwyth. It w agreed at this meeting that membership should confined in the meantime to scientific and technic officers of Ministries, research institutes, war ag cultural executive committees and similar bodi Specialists in countries other than Great Britain c become members.

During the meeting, members visited the Gras land Improvement Station at Drayton, its form substation at Colesbourne in the Cotswolds ar representative grassland areas in Leicestershire. Drayton, herbage crops in seed production and le of different age, history, seeds mixtures and seedi rates were inspected. An interesting feature of t work at Drayton is the increasing emphasis which being placed on the interpretation of sward improv ment through the animal rather than by means botanical or chemical analyses alone; live-weig production trials accompanied the experiments. Colesbourne there were fertilizer trials accompanyin the establishment of leys and the seed productio of various forage crops. Visitors were impressed the productivity obtained from this thin Cotswol soil which only three years ago was derelict turf an dense thorn bush. Those from the north were pa ticularly interested in the crops of sainfoin. In tour through Leicestershire members inspected trial of cocksfoot, perennial ryegrass and other grasse conducted jointly by the Royal Agricultural Societ of England and the Leicestershire War Agricultura Executive Committee at Dunton Bassett and Thorp Langton. They saw the trial now in progress on the famous Mill Field at Medbourne to compare bee production on an old pasture (about one hundred an fifty years old) with that on a new ley in an adjacent field. Members also inspected ley farming and a gras and grain drying plant at Skeffington. Future plans of the Society will be decided shortly. There wil probably be an autumn meeting at which papers will be read and a field meeting next summer in some other part of Great Britain. It is proposed to publish a journal, which will be available to members under their subscription to the Society (21*s.* per annum), and to others at a subscription rate to be decided.

Education and Training of Aircraft Workers

THE Royal Aircraft Establishment of the Ministry of Aircraft Production has just issued an interesting and informative pamphlet on the general subject of aeronautical training. If, says the pamphlet, Great Britain is to maintain its superiority in the air, we must enlist the help of intelligent young men and young women, and give them a training in an attractive career full of possibilities. The basis of the scheme now proposed is the highly efficient technical college which has been built up as an integral part of the Establishment. The scheme set forth in the pamphlet is a system of apprenticeship, the apprentices being of three types: (1) engineering apprentices, who are trained to become aeronautical research engineers, and are drawn from boys who have attained a high standard of secondary school education; (2) craft apprentices, who are trained to become skilled craftsmen for service in laboratories and in experimental work; and (3) laboratory assistants, who are employed in the research laboratories, and must have obtained a school-leaving certificate with credit in science and mathematics. Details are given concerning the course of training for each of the three types of apprentice. The course in each case prolonged and thorough, and it is shown that for ch type there is the possibility and the promise of successful career.

/hat are Comets ?

Ciencia Investigación No. 2, February 1945, con-ins an article with the title "¿ Qué son los cometas ?" y Enrique Gaviola, director of the Córdoba Observa-ory, which gives a short account of comets from ncient times up to the present. There is nothing new the article, but it provides a useful summary of ur knowledge of these visitors, dealing with the ectrograms of the gases in the head and tail, the asses deduced by the perturbations or lack of per-urbations produced by comets, changes in luminosity ue to varying distances from the sun, light pressure n the smaller particles, etc. The author conjectures at the asteroids were once brilliant comets—a view hich is entertained by others, but lacking in con-usive evidence. There is a very fine photograph of Ialley's Comet taken at Córdoba Observatory on Iay 7, 1910.

ecent Earthquakes

DURING January 1945, ten earthquakes were egistered at the seismological observatory at Toledo, pain. The greatest of these was on January 12, hen an earthquake, registering initially at 18h. 52m. 1s. G.M.T., developed an amplitude of 50 μ at 19h. 6m. 13s. G.M.T. on the east-west component. The picentral distance has been provisionally estimated t 12,830 km. During the same month one strong istant earthquake was registered at the Dominion Observatory, Wellington, New Zealand. This was on January 28 at 07h. 37m. 18s. G.M.T. from an epicentral distance of approximately 22°. The shock was also registered at Christchurch, Auckland and Arapuni. In New Zealand there were twelve shocks humanly felt in the Dominion during the month. The greatest of these was on January 2. It was felt with intensity 5 (Modified Mercalli Scale) in the North Island, south of Wairo Taupo and Wanganui. On January 1 a shock was also felt at Wairo with intensity 5 (Mod. Mer.). The United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has determined the provisional epicentre of the earthquake of January 12 to be near lat. 34° N., long. 139° E., which is off the coast of Japan, to the south of Tokyo.

During February 1945, fourteen strong earthquakes were registered at the observatory at Toledo, Spain. The strongest of these occurred on February 10 and registered at Toledo at 05h. 11m. 09s. G.M.T., attaining a maximum ground amplitude at Toledo of 115 μ on the north-south component at 05h. 50m. 35s. G.M.T. The epicentral distance is estimated at 10,440 km. The shock of February 20 is estimated to have had its epicentre 660 km. from Toledo. The earthquake of February 18 was recorded at Kew, as was also that of February 26. The United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has determined the provisional epicentre of the earthquake of February 10, from instrumental reports from twenty-one observatories, to have been at lat. 41·5° N., long. 142° E., which is off the coast of Japan to the east of Hakodate. The initial time was 4h. 57·9m. G.M.T.

During March 1945, Mr. E. W. Pollard recorded seven earthquakes at his observatory at Binstead, Isle of Wight. Three occurred on March 18.

The Film in Science

THE Scientific Film Association is holding a conference on "The Film in Science" at the Technical College, Huddersfield, during August 31—September 2. The opening address will be given by Mr. Arthur Elton, president of the Association, and there will be sessions on the film in education, industry and medicine, and as an instrument of research. Dr. W. T. Astbury will give a lecture on the X-ray examination of proteins. There will be a display of visual aid equipment. Registration forms to attend the conference, and further particulars, can be obtained from the secretary of the Association, c/o Royal Photographic Society, 16 Princes Gate, London, S.W.7.

United Nations Educational Conference in London

A CONFERENCE is to be held in London on November 1 next to consider the establishment of a United Nations Educational and Cultural Organization. The Conference of Allied Ministers under the chairmanship of Mr. Richard Law, Minister of Education, at a meeting in London on July 12, unanimously agreed that the British Government be asked to invite on its behalf the Governments of all the United Nations to send delegates to this conference. A working committee will be set up in London to make preparations for the conference and to assemble and collate opinions and proposals as to the scope and methods of operation of the organization. Draft proposals for the constitution of the organization, prepared by the Conference of Allied Ministers, will be issued shortly and will form the basis of discussion at the forthcoming conference.

Announcements

DR. ALEXANDER S. WIENER, of New York University, has been awarded the Alvarenga Prize for 1945 of the College of Physicians of Philadelphia, "in recognition of his important work upon the various types of *Rh* factors and on their genetic transmission". Dr. Wiener will give the Alvarenga Lecture before the College of Physicians of Philadelphia and the Philadelphia County Medical Society on October 3, 1945, on "*Rh* Blood Factors in Clinical Medicine". This Prize was established by the will of Pedro Francisco daCosta Alvarenga of Lisbon, Portugal, an associate fellow of the College of Physicians of Philadelphia, "to be awarded annually by the College of Physicians on each anniversary of the death of the testator, July 14, 1883". The College usually makes this award for outstanding published work, and invites the recipient to deliver an Alvarenga Lecture before the College.

THE Council of the University of Sheffield has made the following appointments: Dr. H. Motz to be lecturer in engineering physics; Dr. James White to be lecturer in refractory materials in the Department of Metallurgy. Dr. C. Gray Imrie, lecturer in physiology, and Mr. J. MacA. Croll, lecturer in bacteriology, have resigned. Mr. C. H. Hainsworth, lecturer in electrical engineering, and Dr. W. J. Rees, lecturer in refractories, are retiring under the age limit. The Yorkshire Mine Workers' Association is to provide two scholarships in 1946, each of an annual value of £180, open to members of the Association and tenable for a full-time degree course in mining at the University.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Anærobic Metabolism of Spermatozoa

It was shown by Iwanow[1] and Redenz[2] that the presence of oxygen is not essential for the survival of the spermatozoa and that they retain their motility under anærobic conditions provided that glucose is present. Later, it was demonstrated conclusively that the metabolism of spermatozoa is predominantly of glycolytic character[3,4,5,6,7]. Up to the present, however, the studies have been largely confined to the investigations of optimal conditions, various substrates and inhibitors of sperm glycolysis, leaving open the question concerning the glycolytic pathways and the enzymes involved in the anærobic processes. The presence in sperm of adenosinetriphosphate, one of the essential factors of glycolysis, has been assumed on the grounds that the sperm contains a phosphate fraction which breaks down to *ortho*-phosphate after short hydrolysis in acid[8].

The experiments recorded below were carried out mainly with ram semen, which is particularly suitable for metabolic studies because of the exceptionally high concentration of spermatozoa (2·5–5 million per 1 µl. semen). The semen was collected by Dr. A. Walton and Dr. L. Villalobos at the Animal Research Station, Cambridge. It was brought to the laboratory within an hour after ejaculation, it was then diluted with 5–10 volumes of calcium-free Ringer-bicarbonate solution, centrifuged, and finally the sperm was re-suspended in fresh Ringer solution up to the original volume of the whole semen. Aerobically, such a suspension has a high respiratory activity which remains constant for several hours and compares favourably with the respiration of the whole semen. In the presence of added glucose, the respiration is partly replaced by an ærobic glycolysis. Spectroscopic examination of the sperm suspension reveals the spectrum of all three cytochromes. When air is replaced by nitrogen or by a mixture of 95 per cent nitrogen and 5 per cent carbon dioxide, the cytochromes become fully reduced and the glycolysis rises to reach a level of 100–600 mgm. lactic acid per 100 ml. sperm, per hour, at 37°. With such a sperm suspension the following observations were made.

(1) Spermatozoa contain adenosinetriphosphate which was isolated quantitatively in the form of the barium salt. The amino-group was identified by means of the muscle deaminase, the phosphate groups by acid hydrolysis and subsequent estimation of *ortho*-phosphate. The content was 0·6–1·5 mgm. per cent amino-nitrogen and 2·6–6·6 mgm. per cent easily hydrolysable phosphorus.

(2) When spermatozoa are incubated anærobically without glucose, their content of adenosinetriphosphate decreases rapidly, while in the presence of glucose it can be preserved much longer. This behaviour is in agreement with the observation that in spermatozoa stored anærobically motility is maintained more satisfactorily in the presence than in the absence of a glycolysable substrate.

(3) The metabolism of glucose in the sperm is initiated by the shift of the labile phosphate groups from adenosinetriphosphate to glucose. The enzyme which catalyses this reaction resembles the hexokinase of yeast. Using 1 ml. of sperm to which gluco adenosinetriphosphate and 0·04 N fluoride w added, one finds after one hour at 37° that nea half the readily hydrolysable phosphorus of adenosi triphosphate is esterified with the hexose. Witho fluoride a large proportion of adenosinetriphosph breaks down rapidly with the liberation of all th phosphate groups as *ortho*-phosphate. This brea down, however, unlike that in certain other anim tissues, is not accompanied by the deamination the amino-group of the nucleotide; in fact, it h been found that the semen has scarcely any deami ase activity towards adenosinetriphosphate, adeny acid and adenosine. But in semen kept for seve hours under sterile conditions, large amounts ammonia accumulate. This evolution of ammon does not depend on the presence of intact sperm tozoa; it occurs also in the seminal fluid itse Furthermore, it is accompanied by a sharp rise the non-protein nitrogen, which exceeds considerab the ammonia nitrogen.

(4) Monophosphohexose added to a suspension surviving sperm is further phosphorylated in t presence of adenosinetriphosphate. To study t action of the phosphopherase involved in this r action, the Embden ester was used. This compou was scarcely metabolized by the sperm alone an yielded no lactic acid. However, on the additio of adenosinetriphosphate, the Embden ester wa phosphorylated to diphosphohexose and lactic aci was produced. Of 2 mgm. phosphorus added a monophosphohexose to 1 ml. sperm, 26 per cen appeared after 30 min. as readily hydrolysable phosphorus of diphosphohexose.

(5) Diphosphohexose is broken down by spermatozoa and oxidized to phosphoglyceric acid. Th oxidation is coupled with a reduction of pyruvi acid to lactic acid. This reaction is inhibited by 0·001 N iodoacetate but not by 0·04 N fluoride. Th dehydrogenases which catalyse the oxido-reductio depend for their activity on the presence of cozymase. The oxido-reduction is coupled with a phosphorylation of adenylic acid to adenosinetriphosphate. One molecule of lactic acid is formed for each molecule of inorganic phosphate which disappears. For example, 1 ml. sperm incubated anærobically at 37° for 30 min., with 0·6 ml. 0·3 N pyruvate, 0·3 ml. 0·15 N diphosphohexose (Harden – Young ester), 0·4 ml. 0·16 N adenylate, and in presence of cozymase, inorganic phosphate pH 7·3 and 0·04 N fluoride, brought about the disappearance of 1·37 mgm. inorganic phosphorus, and the formation of 3·77 mgm. lactic acid; and synthesized an amount of adenosinetriphosphate corresponding to 0·318 mgm. amino-nitrogen and 1·4 mgm. readily hydrolysable phosphorus.

(6) Phosphoglyceric acid added to the sperm is metabolized very slowly. However, in the presence of adenylate it is rapidly converted to pyruvic, and eventually to lactic acid. The phosphate group of phosphoglyceric acid is taken up by adenylic acid, and reconstituted adenosinetriphosphate is made available again for the initial stages of glycolysis, namely, the phosphorylation of hexose and of monophosphohexose. When 1 ml. sperm was incubated anærobically for 30 min. with 3 mgm. phosphorus in the form of phosphoglycerate, the result was 0·13 mgm. pyruvic acid, 0·3 mgm. lactic acid and 0·25 mgm. inorganic phosphorus. In presence of adenylate, however, the same amount of phosphoglycerate yielded 3·45 mgm. pyruvic acid, 1·62 mgm.

tic acid, 1·3 mgm. inorganic phosphorus, 30 per t of the added adenylate being converted to mosinetriphosphate.

7) All these enzymic processes are not necessarily tricted to anærobic conditions but occur in obically glycolysing spermatozoa as well. They o take place in the sperm of other animals. Bull nen, for example, contains 0·4 mgm. per cent of enosinetriphosphate amino-nitrogen and is distinguished by a high rate of the phosphorylative ido-reduction. No lactic acid is produced from cogen by washed spermatozoa of either ram or bull.

Two major points emerge from this investigation. e fact is established that a close relationship exists tween the activity of the spermatozoa on one hand, d the glycolysis mediated by adenosinetriphosate on the other hand. Next, it is shown that the ycolytic pathways and enzymes involved in the ærobic metabolism of spermatozoa bear resemblance those of other animal tissues and yeast. Hitherto, e study of enzymes concerned with the glycolysis volved for the most part the use of purified systems parated from the cell structure (for example, uscle, yeast); objections were occasionally raised at results obtained in this manner may not depict e true function of those enzymes inside the cells. owever, with spermatozoa the course of reactions talysed by the glycolytic enzymes has been exored in the cells themselves.

This work is being carried out on behalf of the gricultural Research Council.

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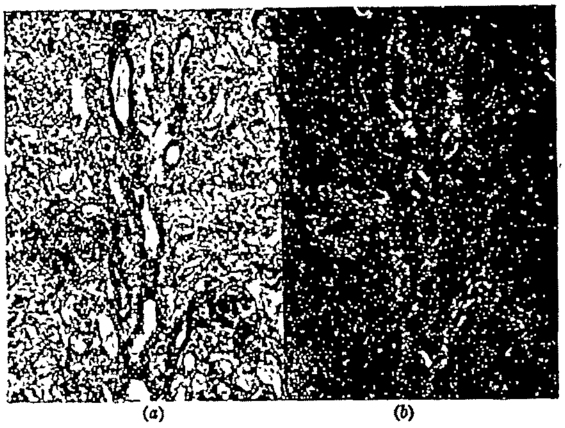
Double-Refringence of the Amyloid-Congo-Red-Complex in Histological Sections

The Congo-red reaction of amyloid in histological ections is the only amyloid stain providing durable preparations. It has, however, so far proved of imited value, as its specificity is compromised by certain hyaline, mucous, fibrinoid or elastic tissue components also 'taking' Congo-red.

We have been able to show that this method can be brought to a very high level of specificity by using it in combination with polarization microscopy. Amyloid structures unstained or stained by the usual routine and other specific methods present no double-refringence of practical importance; but they reveal a very sharp, though not particularly sparkling, optical anisotropy after Congo-red staining (see reproduction). For demonstration, a very bright, unfiltered light source was used. The colour of the effect changes during rotation through 360° of the optical axes of the preparation twice from yellow to green, if conditions are optimal. Other Congo-positive but non-amyloid tissue components do not show this newly acquired double-refringence. Certain hyalines, etc., however, may be strongly anisotropic by themselves, a fact which is argument enough against their being regarded as amyloid.



Kidney (No. Pl. 98/45). Cortical zone with amyloid degeneration of interlobular artery and two Malpighian bodies. Formalin-fixing, paraffin section, 7 μ, hæmatoxylin Congo-red stain: (*a*) between parallel nicols; (*b*) between crossed nicols. × *c*. 50.

Besides the practical importance in histopathology of the phenomenon reported, this 'induced double-refringence' may well be of theoretical interest in connexion with the submicroscopical make-up of amyloid and the physico-chemical mode of interaction between Congo-red as a specific staining matter and amyloid as its 'substratum'. It would, indeed, be most interesting to study similar cases of more or less isotropic systems becoming doubly-refringent by their interaction with isotropic colloidal solutions.

The following details on the effect have so far been gathered (in all experiments, Congo-red from E. Merck, Darmstadt, was used): (1) Congo-red precipitates show no direct optical anisotropy, and Congo-red solutions show no stream double-refringence. (2) The effect depends on the actual presence of Congo-red in the amyloid structures; if the stain is washed out from a section, the double-refringence formerly established disappears. Moreover, the double-refringence appears brighter the more strongly the stain has 'taken', a ratio in which the thickness of the section is equally involved. (3) The effect can be observed in slices mounted in balsam as well as in glycerol, glycerol-gelatine or physiological salt solution. Freezing and paraffin sections do not make any appreciable differences in producing the effect. (4) As to the effect of tissue-fixing, the 'pictures' resulting from formalin and alcohol fixation are equally good. Material fixed in Zenker's solution (containing mercuric chloride, potassium bichromate and acetic acid) proved, however, less favourable; apart from the fact that precipitates occurring in the sections are disturbing by their sparkling double-refringence, the effect, in itself, seems to be far less obvious, even if the precipitates are totally or partly removed by iodine treatment, notwithstanding the fact that the amyloid structures are showing a brilliant Congo-red stain. This might well be the effect of blocking certain reactive groups in the amyloid molecule complex by chromium or mercury, groups which otherwise would have taken part in the reaction with Congo-red. Experiments on this are still in progress; it may be mentioned, however, that iodine treatment of alcohol-fixed material, previous to Congo-red staining, does not necessarily cause a reduction of the ensuing double-refringence. (5) Among acid diazo-stains chemically related to Congo-red and so far tested for similar properties, only Congo-rubin has been found to produce a certain induced anisotropy with amyloid; this effect, however, is not so readily reproduced as in the case of Congo-red. Trypan-red and trypan-blue may or may not have a very slight similar effect.

The following preliminary conclusions have been drawn from the observations: the double-refringence produced by the interaction of amyloid and Congo-red is an essential and not an accidental one; this is evident by its being largely independent of the refractive index of the imbibition liquid. The amyloid-protein substructure seems to include reactive groups in a certain regular distribution and arrangement in space which allow the Congo-red molecule complexes to fit in by means of corresponding reactive groups in such a way as to create a crystal-like structure.

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Stabilization of Penicillin Solutions by Phosphate

ALTHOUGH penicillin in aqueous solution is rather more stable than was originally supposed, there is, nevertheless, an appreciable loss of activity in a few days at room temperature and in a few minutes at 100° C. We have found it possible greatly to stabilize penicillin solutions by the addition of phosphate (Sørensen's buffer solution). That this is not due to an effect on *p*H was shown by parallel experiments with penicillin in water alone, the *p*H of which was carefully regulated to that of the phosphate solutions.

The degree of stabilization depends on the sample of penicillin, the concentration of penicillin in the solution, and the concentration of phosphate. For example, in 15 min. at 100° C. and a concentration of penicillin of 5 u./ml., one sample lost 50 per cent of its activity in water and 5 per cent in *M*/15 phosphate; a second sample lost 25 per cent in water and 5 per cent in phosphate (see table). Different samples differ also in the amount of phosphate which gives maximal protection; with a concentration of 5 u./ml. penicillin, one sample was protected most by *M*/100 phosphate; a second by *M*/30 phosphate, whereas with a third there was increasing protection with increasing phosphate concentration up to and apparently beyond *M*/3 phosphate.

DESTRUCTION OF PENICILLIN SOLUTIONS AT 100° FOR 15 MIN. IN THE ABSENCE AND PRESENCE OF PHOSPHATES. FIGURES GIVE PERCENTAGE PENICILLIN DESTROYED. PHOSPHATE CONCENTRATION *M*/15.

Sample	Concentration of penicillin							
	5 u./ml.		50 u./ml.		500 u./ml		5,000 u./ml.	
	water	phosphate	water	phosphate	water	phosphate	water	phosphate
1	50	5	10	15	30	10	35	5
2	50	5	50	10	70	20	50	15
3	25	5	—	—	5	10	30	10

There are several practical applications of these findings. Perhaps the most important is that solutions of penicillin, which frequently become contaminated with organisms such as *Ps. pyocya* may be sterilized by boiling for a few minutes in presence of phosphate, with but little loss in poten Secondly, if only small quantities of penicillin required out of the usual phial of 100,000 units, addition of phosphate will make it possible to k the unused portion of the solution for several d with little loss of activity.

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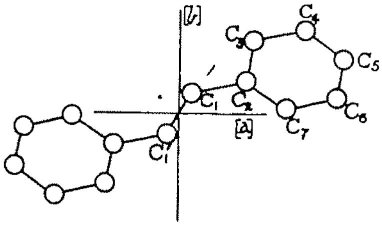
Structure of Dibenzyl

WITH the early work of J. M. Robertson[1] a sound basis, the crystal structure of dibenzyl been determined more accurately, using more th seven hundred experimental structure amplitudes modern three-dimensional Fourier methods, includi the new syntheses devised by A. D. Booth[2]. For t first time in Great Britain, professional aid w enlisted for the laborious calculation of the fi Fourier synthesis and theoretical structure fact through the co-operation of the Scientific Computi Service.



C_6H_5-CH_2CH_2-C_6H_5

The molecule of dibenzyl has a centre of symmetr and with the nomenclature shown in the figure th interatomic dimensions are as follows:

$C'_1—C_1$	1·48 A.	$C_4—C_5$	1·36$_5$ A.
$C_1—C_2$	1·50	$C_5—C_6$	1·36$_5$
$C_2—C_3$	1·37	$C_3—C_4$	1·39
$C_2—C_7$	1·36	$C_6—C_7$	1·39

$C'_1C_1C_2 = 115°$; all angles associated with the benzen rings, 120 ± 1°. The C'_1C_1 bond is inclined at 72° t the plane of the benzene rings.

The atomic parameters were derived directly fro the maxima of the Fourier peaks, and no assumption were made about the fine details of the structure It is therefore possible to get a measure of th accuracy of the analysis from the geometry of th molecule; for example, the opposite sides of th benzene ring are parallel and $C_1—C_2$ is collinear wit $C_2—C_5$ within 0·5°. Discrepancies of this orde suggest that the values given above are reliable t ±0·01 A. and ±1°.

The special interest of these results lies in th acyclic single-bond distances, which are shorter than the normal value of 1·54 A. The system of two benzene rings separated by three single bonds is analogou to the 1:5-dienes and polyisoprenes, and that it should possess unusual structural features is in keeping with observations on this class of compounds instanced by the chemistry of certain carbalkoxyl derivatives of hexadiene[3] and the structure of geranylamine hydrochloride[4].

detailed description of the structure analysis discussion of the results will be published else- ere.

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Crystal Structure of Diamond

N a recent communication in *Nature*[1], Mrs. Lonsdale s questioned the statement made by Sir C. V. Raman[2] t the X-ray data leave the question whether mond possesses tetrahedral or octahedral sym- try of structure entirely open. The present com- nication is a reply to some of the specific points sed in her letter.

As is well known, the structure of diamond consists two interpenetrating face-centred cubic lattices, two atoms in the basis having the co-ordinates 0 and $\frac{1}{4}\frac{1}{4}\frac{1}{4}$. From the fact that the atoms occupy ese special positions in the lattice, it follows that ey must possess tetrahedral (*Td*) symmetry of ucture, which may be visualized by drawing a set planes passing through the atomic nucleus and rallel to the cubic and dodecahedral planes, and ereby dividing up the whole electronic cloud into 4 pyramids. Tetrahedral symmetry requires that the charge distribution in one of these pyramids specified, those in 23 others should also be the same, ese 24. pyramids being distributed (six each) in ur non-adjacent octants of the sphere drawn round e nucleus. The charge distributions in the remain- g 24 pyramids would also be identical, but different om those in the first set.

As a consequence of the tetrahedral symmetry the atoms, the crystal as a whole would also ossess the same symmetry, except in the special ase when the electronic states and configurations of e two atoms are exactly identical and geometrically ymmetric about a point midway between them $\frac{1}{8}, \frac{1}{8}, \frac{1}{8}$). It is easily proved, however, that this special elationship, which results in a higher or octahedral ymmetry for the crystal, is not a necessary condition ither for the non-appearance of the 200 X-ray re- exion nor for the appearance with a low intensity f the 222 X-ray reflexion. The vanishing of the 00 reflexion is secured if the radial distribution of lectronic charge, when *summed up* for a pair of pposed pyramids in each atom, is the same for oth the atoms in the basis. This means that the otal charge in a spherical shell surrounding the ucleus, and consequently also the integrated total harge, is the same for both atoms. The fact that iamond does not exhibit either piezo- or pyro- lectricity thereby becomes intelligible. Further, the 222 X-ray reflexion would only vanish in two special ases, namely, (*a*) when each atom is octahedrally symmetrical, or (*b*) when the atoms are tetrahedrally symmetrical, but the radial distributions of charge are identical in similarly directed pyramids in the two atoms.

Prima facie, neither of these special conditions can be expected to exist; as a result of the valence binding, the electronic distribution would in general tend more towards identity in opposing pyramids than in parallel ones. The appearance of a 222 reflexion is thus naturally to be expected. But any departure, however small, from identity and symmetry of the distributions in opposing pyramids would result in the structure as a whole possessing only tetrahedral and not octahedral symmetry. The spectroscopic behaviour of diamond shows beyond all possibility of doubt that this is so in the majority of cases.

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May 17.

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Energy Spectrum of Mesotrons at Low Energies

THE energy spectrum of cosmic rays has been studied by means of magnetic analysis by Blackett[1], Jones[2] and Hughes[3]. In the present experiment, information regarding the low-energy part of the mesotron spectrum has been obtained from analysis of the absorption curves of cosmic rays in lead and water.

The curves *ABCDE* and *AIJK* in Fig. 1 represent the absorption curves of cosmic rays in lead and water respectively taken under identical conditions. In each case the variation in the number of coincidences with different thickness of absorber interposed between the upper counters of a counter telescope is represented as a function of the absorber thickness.

In the analysis of these curves, it is assumed that the part *CDE* of the lead absorption curve, obtained with a thickness of lead greater than 10 cm., is entirely due to cosmic ray mesotrons. The portion *ABC*, corresponding to a thickness of lead less than 10 cm., represents the rate of absorption of electrons of all energies and of mesotrons with range less than 10 cm. lead or pc less than $2 \cdot 3 \times 10^8$ e.v. (Rossi and Greisen[4]).

The effect of the electronic part of the cosmic radiation transmitted through different thickness of an absorber may be determined from a comparison of the relative absorption in two substances (Greisen[5]). Then by subtraction from the total absorption curve, the rate of absorption of mesotrons alone, separated from that of the electrons, may be obtained.

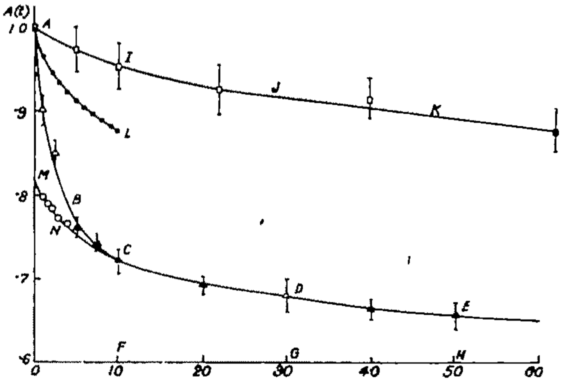

Fig. 1.

We choose water and lead as the two absorbers because the critical energies of these substances differ very greatly. In the case of water, the critical energy is higher and is $1 \cdot 1 \times 10^8$ e.v. As the radiation loss for electrons becomes appreciable for energies higher than the critical energies, and as at sea-level there are very few electrons above 10^8 e.v., one may reasonably assume that the water absorption curve *AIJK* represents mainly the rate of stoppage of electrons and mesotrons due to ionization only.

Now, so far as ionization loss is concerned, 1 cm. of water is equivalent to 0·16 cm. of lead. With this reduction ratio, the curve *AIJK* may be reduced to the lead scale. The reduced curve is shown by *AL*. *AL* represents the rate of absorption of cosmic particles in lead if there were no radiation loss, whereas the actual curve *ABC* represents the rate of absorption of mesotrons due to ionization and of electrons due both to radiation and ionization.

If we extrapolate the absorption curve beyond 10 cm. which is due to mesotrons only in the same ratio as the curve *AL*, we obtain the complete absorption curve of mesotrons and of those electrons which are stopped due to ionization in lead, that is, with energies below the critical energy of lead, 7×10^6 e.v. The curve *MNCDE* obtained in this way really represents the absorption of cosmic ray mesotrons in lead, as electrons with energies less than 7×10^6 e.v. will be stopped by the walls of the counter.

As a check on this result, we have used the calculations of Bhabha[6]. He recently estimated the number of cosmic ray electrons that may be expected to be recorded at sea-level by means of a counter telescope, such as we have used, with different thicknesses of lead interposed between the counters. The ordinates of the total lead absorption curve *ABC* may be corrected for the number of transmitted electrons as suggested by Bhabha. The calculated points indicating mesotron intensity alone are shown in the graph by circles and are found to lie on the curve *MNCDE*, proving that this is entirely due to cosmic ray mesotrons.

In order to obtain the differential energy spectrum from the absorption curve, we assume that for a mesotron of a definite energy E, there is a fixed range of R cm. of lead. The ordinate of the absorption curve $A(t)$ at a thickness t cm. may then be represented as

$$A(t) = \int_t^{R_0} n(R)dR = \int_E^{E_0} n(E)dE, \quad . \quad . \quad (1)$$

where $n(R)dR$ and $n(E)dE$ represent the fractional number of mesotrons with range between R and $R + dR$, or with energy between E and $E + dE$. The limits of the integrals extend from any thickness t of the absorption curve or from the corresponding energy E of the energy distribution curve to the maximum range R_0 or the limiting energy E_0 of the mesotron spectrum. Then

$$n(E) = -\frac{dA}{dE} = -\frac{dA}{dt} \Big/ \frac{dE}{dt} \quad . \quad . \quad (2)$$

$\frac{dA}{dt}$ is determined from the corrected absorption curve *MNCDE* and $\frac{dE}{dt}$ for mesotrons of mass 200 m. has been calculated by Rossi and Greisen[4]. Thus the differential mesotron spectrum may be obtained from the absorption curve.

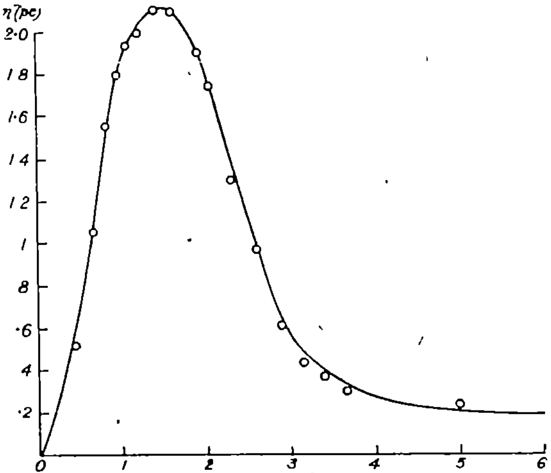

Fig. 2. Differential mesotron spectrum.

The result of the above analysis is shown in Fig. The shape of the differential spectrum is similar that obtained by Jones and Hughes, but the peak the spectrum appears to be shifted to much low energies. The results therefore show that there i considerably larger number of slow mesotrons sea-level than is commonly believed; these sl mesotrons are possibly excluded in counter-controll cloud chamber measurements. Alternatively, it also possible that dE/dt for low-energy mesotrons much greater than that given by the simple ionizati formula.

Our thanks are due to Prof. M. N. Saha for pr viding facilities for this work and for his continu interest in it.

S. K. GHOSH.
N. N. DAS GUPTA.

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[1] Blackett, P M. S., *Proc. Roy. Soc.*, A, **159**, 1 (1937).

[2] Jones, H., *Rev. Mod. Phys.*, **11**, 235 (1939).

[3] Hughes, D. J., *Phys. Rev.*, **57**, 592 (1940).

[4] Rossi, B., and Greisen, K., *Rev. Mod. Phys*, **13**, 240 (1941).

[5] Greisen, K., *Phys. Rev.*, **63**, 323 (1943).

[6] Bhabha, H J., *Proc. Ind. Acad. Sci.*, **19**, 23 (1944).

Production of Difference Tones

IN providing a course of instruction in preliminar radio physics for war purposes, there were in ou laboratory several audio-frequency generators whic were capable of producing tonal frequencies up t and above the limits of hearing. It occurred to m that with two such instruments difference tones migh easily be generated. The instruments were connected, preferably in parallel, with a small loud speaker, and the pitch of each was gradually raised by itself to a frequency just above the limit of audibility When both instruments were simultaneously adjustec by the dial to the same high frequency, no tone wa heard. But when one of them was altered to a smal extent, a deep low difference tone of a frequency near the lower limit of audibility was loudly heard by itself. By gradually changing the frequency of on generator, the pitch of the difference tone rises con uously to any height desired. It is sufficiently loud be heard over a large lecture room, and is now so monstrated.

It makes a very convincing experiment to produce difference tone when all three tones are heard once, and then gradually raise the pitch of the nerating tones above the audibility limit, finally ving the difference tone to be heard alone. The ect is by far the best that I have ever been able obtain with 'tonvariators' of any kind. The method ems to be of no use in generating audible summation nes since, as in all methods, the necessary low tones ask the summational higher ones. It may be the se that this method of generating difference tones s been used by others though I have never seen reference to it.

Prof. H. F. Batho has directed my attention to e fact that difference tones can also be produced two radio-frequency generators similarly arranged, here the generating frequencies are of the order of couple of thousand kilocycles per second. In this se the variable condenser which changes the freency of one generator needs to have its capacity tered only a very small amount in order to cover e audible range. But more gradual tuning can be ade by connecting a second small variable conenser in parallel with the first, so that a considerable ovement of the plates of the second will be required carry the pitch of the difference tone through the nge of audibility. It is interesting to note that ifference tones can be generated by two frequencies f any magnitude up to several million cycles per econd.

FRANK ALLEN.

University of Manitoba,
Winnipeg.

Units for Degree of Vacuum

MR. TOWNSEND's recent suggestion for a new unit for degree of vacuum based on the logarithm of the numerical value of the pressure in millimetres of mercury is to be welcomed. The new unit successfully removes the clumsy expressions of the present convention. It is also appropriate to adopt 1 mm. mercury pressure as the reference-level for the new system with logarithm of a pressure ratio.

In defining the new unit there is, however, no need to have an analogy with the definition of the decibel in the method of measuring power ratios; the analogy should rather be with the definition of the bel, one decibel being one tenth of a bel, and being used for the sake of obtaining more convenient quantities in communication engineering problems. Thus the new pressure unit ('vacuum unit') should be defined so that a pressure of a mm. of mercury becomes $A = \log_{10} \dfrac{1}{a} = -\log_{10} a$ 'vacuum units'.

May I further be allowed to suggest that the name for the new unit might be "McLeod". A pressure of, say, 1×10^{-5} mm. Hg would thus read 5 McLeods, 1×10^{-6} mm. Hg would become 6 McLeods, and 3×10^{-6} mm. Hg would be equal to $6 - \log_{10} 3 = 5{\cdot}52$ McLeods.

R. FEINBERG.

University,
Manchester.

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[1] *Nature*, **155**, 545 (1945).

I SHOULD like to comment on Mr. F. H. Townsend's[1] recent communication to this journal, in which he proposed a logarithmic scale of pressure for high-vacuum work.

These new vacuum units provide us with a valuable method for measuring pump speeds. When a pump evacuating a closed vessel into which leakage is inappreciable—a case of great practical interest—is operating at constant speed by volume, the pressure in the vessel is falling exponentially towards zero. Thus the height of vacuum measured in Townsend's units is increasing linearly. I suggest, then, that the speed of a pump may be measured by the rate of increase of vacuum (in the new units) which it produces in such a closed volume of standard size. In fact, if the speed of the pump be V volume units per second, it is 10 V vacuum units per volume unit per second, taking the volume of the standard vessel equal to the original unit. Thus the maximum speed of the pump referred to in Mr. Townsend's letter is 860 'vac.'/cu.m./hr. at 38 'vacs.'. An advantage of this method is that the calculation of how long it will take to exhaust a given vessel to a given vacuum affords rather less scope for arithmetical errors.

As regards naming the new unit, why not call it 'vacuum unit' and, as above, abbreviate it to 'vac.'?

G. A. P. WYLLIE.

Department of Applied Physics,
University, Glasgow.
May 13.

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[1] Townsend, F. H., *Nature*, **155**, 545 (1945).

Hexachlorocyclohexane as an Insecticide

MR. E. L. TAYLOR has given[1] an account of work on the acaricidal properties of a 'new' insecticide of the general formula $C_6H_6Cl_6$ (hexachloro*cyclo*hexane). This substance has been available in France for some years under the trade name of 'Aphtiria'. It would appear that a patent covering the method of preparation was taken out in France by M. Louis Gindraux in 1941. It has been used as an insecticide during the War in large quantities by the French Government with excellent results.

The disagreeable odour which is associated with hexachlorobenzene can be masked fairly easily, as the concentration of the active agent is rarely above 2 per cent when used as an insecticide. M. Gindraux (in a personal communication) believes that it is possible to prepare it free from an offensive smell and is engaged actively on the problem.

As most of the experiments which have been conducted have necessitated the use of organic solvents such as acetone, kerosene, etc., it should be noted that these are themselves active causers of dermatitis in man and that cases of skin involvement are common when used in industry.

It is, however, possible that a satisfactory cream will be produced containing an adequate concentration of hexachloro*cyclo*hexane which can be used for the treatment of scabies in man.

L. B. BOURNE
(Medical Officer).

A. C. Cossor, Ltd.,
Highbury Grove,
London, N.5.
May 25.

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[1] *Nature*, **155**, 393 (1945).

THE VITAMIN B_2 COMPLEX

AT a joint meeting of the Nutrition Society and the Biochemical Society held on April 28, at the London School of Hygiene and Tropical Medicine, the subject of the vitamin B_2 complex was discussed. The chairman of the morning session, Prof. R. A. Peters, reviewed the early history of vitamin B, describing the experiments on the basis of which the heat-labile vitamin B_1 was differentiated from the heat-stable vitamin B_2, and the composite nature of the heat-stable component was eventually recognized. He read a prophetic passage from a letter written many years ago by Sir Charles Martin, suggesting that vitamin B might be composed of several different factors.

The story was further elaborated by Dr. L. J. Harris and Dr. E. Kodicek in a paper entitled "The Nutritional Significance of the Vitamin B Complex". The vitamin B_2 complex can be sub-divided into the adsorbable factors nicotinamide, riboflavin and pyridoxine, the filtrate factors pantothenic acid, *p*-amino benzoic acid, inositol and choline, and a third group comprising biotin, the folic acid group and the grass juice factor. The history of each of these factors and their biological properties were discussed in turn.

Nicotinamide cures pellagra in man, black-tongue in dogs and a corresponding condition in monkeys and pigs. Riboflavin deficiency in man is accompanied by characteristic symptoms. Deficiencies of pyridoxine and pantothenic acid cause a dermatitis in rats and chickens respectively, while biotin cures a seborrhœic pellagra in rats caused by the avidin of egg-white. Choline is a biological methylating agent and can be replaced by methionine. The relationship between folic acid, vitamin B_C, vitamin H and the *L. casei* ε factor was briefly discussed. Nicotinic acid, riboflavin and probably pyridoxine, like aneurine, are components of enzyme systems essential in carbohydrate metabolism.

This point was discussed in more detail by Dr. J. H. Quastel, in a paper on "The Parts Played by Members of the Vitamin B Complex in Enzyme Systems". Aneurine pyrophosphate is co-carboxylase, the coenzyme of pyruvate oxidation; as such, it catalyses a large number of reactions. Magnesium takes an important role in the transformation of pyruvic acid, and may be part of the enzyme carboxylase. Aneurine also appears to be necessary for the oxidation of α-keto-glutarate, important in transaminations and in the oxidation of acetic acid. Nicotinic acid is present in the coenzyme involved in hexose monophosphate oxidation and in cozymase, the coenzyme of alcoholic fermentation. During oxidation of the substrate it undergoes reduction, and is afterwards reoxidized by flavo-protein, the nicotinamide nitrogen being the site of the successive oxidation and reduction. Cozymase combines with numerous specific proteins to form dehydrogenases capable of oxidizing a variety of substrates. It is also associated with amino-acid oxidations, since in transaminations it catalyses the reconversion of glutamic acid into α-ketoglutaric acid. Riboflavin is also a component of a respiratory enzyme, flavo-protein, which will oxidize reduced cozymase; the *iso*alloxazine nucleus is the seat of the oxido-reductive changes. Reduced flavo-protein is auto-oxidizable, but *in vivo*, it is oxidized by cytochrome; it can also be oxidized by such dyestuffs as methylene blue and by pyocyanine. Pyridoxine is also part of an enzyme system, pyridoxal phosphate being identical w tyrosine decarboxylase, while pantothenic acid believed to be concerned with pyruvate metabolis

Mr. F. A. Robinson discussed "Some Recen Characterized Members of the Vitamin B_2 Comple He distinguished between aneurine, riboflavin a nicotinic acid, which are associated with clea defined deficiency diseases, and the other members the vitamin B_2 complex, which are not. Pyridoxi was the first of the newer factors to be characteriz and synthesized, and recently two of its derivativ pyridoxal and pyridoxamine, have been shown to concerned with transaminations, while pyrido phosphate is apparently identical with tyrosi decarboxylase. The 'filtrate factor', now call pantothenic acid, and biotin have also been sy thesized. All three of these substances are componen of 'bios' and are essential for the growth of a numb of micro-organisms. Uncomplicated biotin and pant thenic acid deficiencies, not artificially induced, ha not been encountered in man. Another substan which was first recognized by its ability to stimula the growth of micro-organisms is folic acid. Th appears to be identical with a growth-factor f chicks, the so-called vitamin B_C, and with th so-called *L. casei* ε factor; both vitamin B_C and fol acid prevent anæmia and leucopenia in chick Recently it was shown that α- and β-pyracin, th lactones of the acids derived from pyridoxine, als prevent anæmia in chicks. Folic acid also preven the anæmia and other symptoms induced by ad ministration of certain sulphonamides, and part relieves the symptoms of vitamin M-deficiency i monkeys. These are also partially relieved b xanthopterin, the fish anæmia factor, while folic aci is partially effective in fish anæmia. There appear to be a close chemical as well as biological relation ship between these factors, but this cannot be substantiated until pure folic acid is available. *p*-Amino benzoic acid is another growth-factor for micro organisms now included in the vitamin B_2 complex and a large number of others have recently bee described about which little is as yet known. Th lipotropic factors, inositol, choline and methionine which prevent fatty-liver formation, are regarded as constituting a third sub-group of the vitamin B_2 complex.

Dr. B. C. J. G. Knight read a paper on "Growth-Factors and Growth Inhibitors for Micro-organisms". He gave a list of the growth-factors known to be required by different micro-organisms; some of these are themselves components and possibly precursors of more complex factors. Researches into growth-factors indicated that certain fundamental metabolic processes are common to the life of all cells, and Fildes suggested the term 'essential metabolite' to indicate a substance which participates in such processes. An essential metabolite that cannot be synthesized by an organism is a growth-factor for that organism. Woods showed *p*-aminobenzoic acid to be a specific antagonist for sulphanilamide, and predicted that *p*-aminobenzoic acid would be an essential metabolite. The prediction has been fulfilled and has led to a search for other growth-inhibitors capable of antagonizing known growth-factors. As a result, inhibitors such as pyridine-3-sulphonic acid and 3-acetylpyridine modelled on nicotinic acid, pantoyl taurine and *iso*riboflavin modelled on pantothenic acid and riboflavin respectively, and others modelled on biotin had been prepared. It has also been discovered that the antibiotic effects of mepacrine, thylene blue, quinine and propamidine are neu- lized by riboflavin, but the antagonistic action is bably more complex than in the other instances en. The growth-stimulating properties of aneurine neutralized by pyrithiamine, the effect being nplete or partial according to whether the organ- as require the whole or only a part of the aneurine lecule. It had also been observed that the pyro- osphate of the thiazole moiety of aneurine will ibit carboxylase activity, suggesting that cocarb- ylase and the thiazole pyrophosphate compete th one another for the carboxylase protein.

Dr. F. Bergel, opening the discussion on these pers, said there are reasons for differentiating tween the major vitamins, aneurine, riboflavin and otinic acid, and the minor vitamins, other than reasons mentioned by Mr. Robinson. He pointed t that the major vitamins are highly specific in eir action, only very closely related substances ing effective, whereas the minor vitamins can be placed by a number of analogues, and he cited ntothenic acid and its derivatives as an example. her speakers in the discussion, however, deprecated e attempt to distinguish between major and minor tamins, and suggested that in a few years time, th groups may be regarded as equally important. ere was also disagreement with the suggestion that ic acid, vitamin Bc and the *L. casei* ε factor are entical.

At the afternoon session, under the chairmanship Dr. L. J. Harris, Dr. B. S. Platt read a paper on ermentation and Human Nutrition". He showed series of slides, illustrating the manufacture of affir beer, and compared its nutritional value with at of British beer. Although the latter contains preciable quantities of vitamins, it contains far less an Kaffir beer, and it was believed that this drink pplies factors which are otherwise lacking in the ative diet. This was clearly brought out by a study f natives in the West Indies, who suffered from arious deficiencies such as greying of the hair, heilosis and various forms of dermatitis unknown mong similar races in Africa where Kaffir beer is a taple article of diet. Investigation showed that when ereal grains germinate, the amounts of most members f the vitamin B complex present increase and that nost of these factors are extracted in the steeping rocess, so passing into the resulting liquor. Although uminants undoubtedly rely on fermentation in the umen as the main source of supply of the vitamin B actors, it is not yet possible to state with certainty what contribution is made by bacterial fermentation n the intestinal tract to the vitamin requirements of an. Later, Dr. Platt showed a series of slides, some n colour, illustrating the symptoms of vitamin eficiency encountered during his recent visit to Labrador and Newfoundland.

Dr. Lucy Wills spoke on "The Vitamin B Complex in Anæmia", dealing especially with nutritional macrocytic anæmia and its relation to Addisonian pernicious anæmia. Nutritional macrocytic anæmia has formerly been regarded as due to a deficiency of an extrinsic factor which, according to Castle, is converted by the action of the intrinsic factor in the gastric juice into the anti-pernicious anæmia factor, which is stored in the liver. If Castle's theory is justified, nutritional macrocytic anæmia should be cured by any extract active in pernicious anæmia however given, but this is not the case. Dr. Wills therefore advanced an alternative theory, that this type of anæmia is due to the absence of a factor belonging to the vitamin B_2 complex which does not, as Castle postulated, react with the intrinsic factor to give the liver principle, nor is it an essential part of the latter, though necessary for its proper functioning. In support of this theory, Dr. Wills stated that uncomplicated nutritional macrocytic anæmia in Bombay does not respond to purified liver extracts, but does respond to crude liver extracts and to yeast extracts by injection as well as by mouth. Furthermore, monkeys, in which a similar type of anæmia has been artificially induced, also respond to crude, though not to purified, liver extracts given by mouth or by injection, and to yeast extracts administered by either route. This shows that it is not necessary for the responsible factor to come into contact with the gastric juice. Just before the War, attempts were made to isolate the factor from liver extract; and although it was established that riboflavin, pyridoxine, pantothenic acid and probably nicotinic acid are ineffective, no conclusive results were obtained, as the work was interrupted.

In opening the discussion on the afternoon's papers, Dr. F. Prescott suggested that synthesis of the vitamin B complex by bacteria in the intestine is not of great importance in man. Najjar and Holt gave aneurine in amounts greatly in excess of the physiological requirements and, when the experiments were repeated with smaller amounts, no evidence that the vitamin was excreted in the urine was obtained. Dr. Prescott suggested that the results of sulphonamide treatment are due not to inhibition of bacterial synthesis, but to direct interference with the respiratory mechanism of the body, simulating the effects of irradiation sickness and drug anæmia.

Speakers who took part in the subsequent discussion supported Dr. Platt's view as to the nutritional value of native-fermented liquors, and cited other examples of how native populations made good a deficiency of the vitamin B factors, for example, by drinking the contents of the rumen of freshly killed animals. The necessity for providing an adequate diet for the Colonial populations was stressed. The proceedings of the meeting were summarized by Dr. Harris, bringing to a conclusion a memorable meeting, which attracted a very large audience.

GENETIC TYPES OF MANGANESE DEPOSITS

A COMPARATIVE study of the manganese deposits of the U.S.S.R. by A. G. Betekhtin, based on intensive investigations carried out during the last few years, adds considerably to our knowledge of the conditions governing the formation of manganese ores (*Bull. Acad. Sci. U.R.S.S.*, No. 4, 3; English summary, 43; 1944).

Three groups of marine manganiferous sediments are distinguished:

(*a*) Most of the Palæozoic and Tertiary deposits are associated with siliceous and less common ferruginous chemical sediments, including radiolarian jaspers frequently accompanied by volcanic tuffs. The Tertiary ores of Chiatura, Transcaucasia and Polunochnoye, N. Urals, furnish typical examples similar to the classic deposits of Nikopol in the Ukraine. In the shallow-water facies formed near a shore of Cretaceous limestone, coarse pisolitic and massive psilomelane and pyrolusite occur. Farther out, the pisolites decrease in size, manganite becomes important and the silica and phosphorus contents increase. Still farther out, under conditions of oxygen deficiency, carbonates appear (rhodocrosite and manganocalcite) with glauconite, and there is marked enrichment in phosphates, sulphides and opal. Eventually the carbonates feather out and finally the ore-horizon is represented only by rare nodules of phosphorite.

(*b*) Deposits associated with calcareous sediments occur in the mountain ranges of west and central Siberia. They are mostly of late Pre-Cambrian age, but important occurrences are also found in the Cambrian of the Alatau. In the western Urals there are similar deposits of Permian age. The chief ore mineral in this type is manganocalcite.

(*c*) Deposits associated with clastic sediments are represented at Labinskoye in the Tertiary of the North Caucasus. Chemical sediments are absent and the ores (psilomelane, pyrolusite or manganese carbonates) occur as cementing material.

In regionally metamorphosed deposits, formed originally by sedimentation, anhydrous minerals are characteristic, for example, braunite and hausmannite, associated with magnetite and hæmatite and quartz. The waters liberated during metamorphism have given rise to veinlets which are mineralogically closely related to the enclosing rocks. Specific cases of this kind in Lower Carboniferous chemical sediments (siliceous and ferruginous) of Kazakhstan are described by Betekhtin and Suslov in the publication cited (pp. 86–99 and 100–108 respectively). Under conditions of more intense metamorphism, manganese silicates develop (rhodonite, spessartite, tephroite, piedmontite, etc.), and carbonate ores poor in silica form manganous marble. Here again, especially along belts of tectonic disturbance, migration and redistribution of manganese is indicated by the occurrence of veins and lenses of concentrated ore. These veins, though otherwise resembling hydrothermal deposits, are free from elements such as gold, silver, lead and zinc ; their origin is purely metamorphic. Vein and contact metasomatic deposits genetically connected with the hydrothermal activity of associated acid plutonic rocks are of far greater abundance and importance. The ores vary widely in composition and structure and often occur with a typical assemblage of sulphide minerals. In many of these deposits, however, there is evidence that the manganese compounds were not magmatic derivatives, but were taken from the manganiferous country rocks through which the hydrothermal solutions circulated.

All the above types of manganese deposits become secondarily enriched by weathering processes in the zone of oxidation, the end product being a pyrolusite-psilomelane complex. Betekhtin directs attention to the widespread development in the early stages of weathering of a manganic 'acid', H_2MnO_3, which occurs as dispersed colloidal particles (brown) or as colloform masses (black). Previously mistaken for manganite, this mineraloid is now distinguished as 'vernadite' after the geochemist Vernadsky, who originally predicted its discovery as a natural product. It is suggested that the various members of the psilomelane group may be salts of this acid. Concentration by chemical weathering is further intensified by the tendency of manganese hydroxides to migrate in colloidal solution and, activated by adsorbed alkali cations, to replace quartz and silicate minerals metasomatically.

ARTHUR HOLMES.

CHESHUNT EXPERIMENTAL STATION

THE Experimental and Research Station Cheshunt, Herts, has given a valuable lead the changing demands of war-time cropping of glasshouse industry. Discussion of problems relat to tomato and lettuce culture occupies all the ann report for 1943* and provides an index to the c centration of the industry upon food crops.

One of the most interesting items in the report the director, Dr. W. F. Bewley, is of trials of t Russian varieties of outdoor tomatoes. Stambo Alpatyev has a neat dwarf habit, bears fruit of g shape, scarlet and sweet ; it seems well worth furt trial. Bizon proved to be coarser, and gave ba shaped fruit, though neither variety was resist to frost exceeding two or three degrees. Two n varieties of lettuce, *5a* and *5b*, are being tested cc mercially ; they mature ten to fourteen days earl than Cheshunt Early Giant. One important expe ment with tomatoes involved the lowering of *p*H the soil by the addition of sulphur and sulphu acid. Sulphur, at the rate of 4 oz. per square ya gave only a slightly increased yield of fruit, but t soil, originally *p*H 8·79, was still *p*H 7·45 at the e of the season. Sulphuric acid caused the soil *p*H fall from 8·62 to 6·39 in a week ; but within a mon it had risen again to 7·84. It would seem that so upward movement of soil bases takes place. It fairly easy to make soil more alkaline, but it is not easy to render it more acid, and the results of a further work on these lines will be awaited wi interest.

An earlier annual report described resistance of t tomato varieties Riverside and Manx Marvel attack by the fungus *Verticillium albo-atrum*. Th does not now seem to hold under all cultural co ditions, according to P. H. Williams. I Selman has had a similar action of soil conditio in mind in his attempts to provide cultural facto which would enable tomato plants infected wi spotted wilt virus to carry a reasonable crop. Th should be a very practical approach to minimizi the damage caused by this disease, provided that it linked with adequate hygiene at the end of th season. Dr. Selman's work on this question is n very conclusive as yet, but his correlations of mosa infection and soil conditions with blotchy ripenin have given much more definite results. Unequ ripening seems to depend largely upon the wate retaining properties of a particular soil mixtur Steaming and the addition of peat without appropriat manurial adjustments, or the use of composts wit extreme fluctuations in water content, both favou the trouble, which is, moreover, always increased b mosaic infection. Mrs. Enid Sheard has investigate the pathology of tomato stem rot caused by th fungus *Didymella lycopersici*. The pathogen is mor virulent if it has wintered out of doors than a temperatures of about 59° F. Tomato seed does no seem to carry the fungus, and the only really sus ceptible alternative host so far discovered is th egg plant, *Solanum melongena*. Many organic sub stances allow saprophytic growth of the fungus which seems to grow best at a temperature of 20° C W. H. Read has tried many substances and treat ments for control, without much success, thoug ures containing salicylanilide give promise of ection upon the stems.

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* Twenty-ninth Annual Report of the Nursery and Market Garde Industries' Development Society, Ltd., Turner's Hill, Cheshunt, Herts 1944.

. R. Speyer, studying the red-spider mite, s that the application of top-dressings does not k infestation, and the use of petroleum emulsions ides the most practical control. The growth of at seedlings to act as bait for wireworm reduced r attack upon lettuce. O. Owen has investi- d the interrelations of various nutrient elements the tomato crop. Magnesium deficiency, for nple, is related to nitrogen, and iron to man- ese, while manganese and magnesium are ibly interdependent.

STRUCTURE OF BIOLOGICAL IBRES AND THE PROBLEM OF MUSCLE*

' is the mark of present-day biology that it looks ever more closely to "the Nature and Property of al Motion" of the actual molecules of structures, d it is from such a point of view that the problem muscle is again approached.

he physico-chemical mechanism of life is for the st part a manifestation of the forms and activities chain-molecules, chief among which are the pro- ns, which include myosin, now generally accepted the responsible contractile element of the muscle chine. X-ray studies show that myosin is a mem- r of a *family* of fibrous proteins to which belong o the keratins of hair, etc., the fibrous proteins the epidermis, and even fibrinogen and fibrin : all ese are characterized by a similar molecular plan d by similar long-range elastic properties that rest i changes of form of the molecules themselves. The ference is that muscular activity is a special case more general phenomena the full interpretation of hich implies an understanding of the properties and gnificance of the keratin-myosin-fibrinogen group s a whole.

The isolated proteins of this group—and this holds o for the myosin in living muscle—exist normally in state in which the polypeptide chains are in a egularly folded configuration, but they may be ulled out into an extended configuration that is wice as long, and they may also be 'supercontracted' nto more highly folded states. X-ray diffraction atterns of muscle, both living and dead, are throughut analogous to patterns that may be obtained from nammalian hairs, the 'supercontracted' state of the atter corresponding to the contracted state of the ormer. The outstanding common conclusion to be lrawn from these photographs is that shortening is not a question of simple disorientation of fibrils, but ather of folding within fibrils.

Thermodynamic tests show that entropy changes play only a minor part in the elastic properties of keratin and isolated myosin, from which it is reasonable to suppose, especially in the light of the X-ray findings, that the various states of muscle itself are also based fundamentally on the potential energy associated with states of folding of the myosin chains. It now appears from recent physiological evidence that such a concept does indeed promise to coordinate quantitatively the energetics of living muscle.

A detailed solution of the muscle problem will be reached only as part of the detailed elucidation of protein structure, studied against the background of other macro-molecules, such as the nucleic acids and polysaccharides, with which protein activity is so intimately bound up. X-ray analysis is now being supplemented by investigations with the electron microscope, and some of the evidence so obtained was presented.

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* Substance of the Croonian Lecture delivered before the Royal Society by Dr. W. T. Astbury, F.R.S., on July 12

METER AND INSTRUMENT JEWELS AND PIVOTS

IN order to obtain a more fundamental knowledge of the phenomena relating to meter and instrument bearings and to improve such bearings, research has been carried out for a number of years on behalf of the British Electrical and Allied Research Industries Association at the Meter Testing Laboratories of the Northmet Power Company. A paper read by G. F. Shotter before the Institution of Electrical Engineers in London on May 4 gives a brief survey of the various aspects covered by this research, dealing mainly with the sapphire/steel combination but including other combinations of materials.

The apparatus and methods of test are outlined, followed by a survey of the results from life-tests, including an analysis of the various factors which contribute to wear. The results of a microscopical examination of the units at the end of their life-run are discussed. A brief theory of the boundary lubrication existing in such bearings is given, with a short extract of the detailed discussion of the various factors contained in E.R.A. Reports.

The results of experiments on the resistance of sapphire jewels to impact forces are given; and the phenomena associated with bottom bearings at various loads, caused by parasitic forces existing in meters, are also dealt with. The actions of the ball-type bearing and that of the pivot bearing are compared, and an approximate estimation of the life of bearings in practice, based on life-tests, is made.

A brief summary of the general conclusions reached during the tests is as follows. (*a*) Metals so far tried as alternatives to steel for pivots are in no way superior. The best material tested was osmium-rhodium, which gave good results in the dry as well as the lubricated condition. (*b*) With the exception of osmium-rhodium and possibly natural zircon (90°), the substitute materials tested, particularly glass, proved useless in the dry condition. (*c*) Various forms of oxide were produced, each having its own characteristics; one or two appeared to be self-lubricating. (*d*) The initial friction of substitute materials was generally higher than that of the steel/sapphire units. (*e*) With the exception of diamond, the substitute materials tested generally show a higher coefficient of friction than the steel/sapphire units. (*f*) The range of penultimate/ultimate test values of friction shows considerable variation. Some materials, for example, natural zircon (90°), show a lower value than that of steel/sapphire. Other units, notably glass, give extremely high values, particularly in the dry condition. (*g*) The type of wear area formed depends on the structure of the materials under test. Homogeneous and amorphous materials normally give circular wear.

FORTHCOMING EVENT

Tuesday, July 24

Quekett Microscopical Society (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 7 p.m.—Conversation and the Exhibition of Specimens.

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned.

Principal of the Gainsborough County Technical College—The Director of Education, County Offices, Lincoln (July 30).

Engineering Assistant—Mr. P. Wilkinson, Staffordshire Potteries Water Board, Engineer's Offices, Albion Street, Hanley, Stoke-on-Trent, endorsed 'Engineering Assistant' (July 30).

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NATURE

o. 3952 SATURDAY, JULY 28, 1945 Vol. 156

CONTENTS

Page
ale in Industry 91
pical Pedology. By Dr. A. Muir 93
dy of Earthquakes. By E. Tillotson . . . 95
ching of Pharmacognosy. By Dr. W. O. Howarth 96
anced Organic Chemistry. By Prof. John Read, .R.S. 96
rication of Metal Surfaces by Fatty Acids. By Dr. . P. Bowden, J. N. Gregory and Dr. D. Tabor . . 97
chemical Aspects of Mental Disorder . . . 101
ituaries :
  Sir Peter Chalmers Mitchell, F.R.S. By Dr. Edward Hindle, F.R.S. . . . 103
  Brigadier-General Sir Percy Sykes. By Dr. J. V. Harrison ; Prof. V. Minorsky . . 104
  Prof. L. I. Mandelstam. By Prof. P. Kapitza, F.R.S., Prof. A. Joffé and Prof. S. Vavilov . . . 105
ws and Views 106
tters to the Editors :
  Regeneration of Mammalian Striated Muscle.—Prof. W. E. le Gros Clark, F.R.S. . . 109
  Motor Response from Giant Fibres in the Earthworm.—Dr. W. A. H. Rushton . . . 109
  Cell Contents of Pus.—Dr. F. Duran-Jorda . . 110
  Heat Injury in Insects.—G. T. Jefferson . . 111
  Mode of Entry of Contact Insecticides.—W. H. Potts and F. L. Vanderplank . . . 112
  Congo Red Fibrin Powder for Experiments on Proteolytic Enzymes.—D. G. Duncan and Dr. H. Zwarenstein 112
  Action of Mepacrine on Diamine Oxidase.—Dr. H. Blaschko and Ruth Duthie 113
  Effect of Alpha-Ray Bombardment on Glide in Metal Single Crystals.—Prof. E. N. da C. Andrade, F.R.S. 113
  A New Approach to Relative Cosmology.—Prof. L. Infeld 114
  Infra-Red Spectrum of the Night Sky.—R. Herman, L. Herman and Prof. J. Gauzit . . 114
  Behaviour of Ultra-Violet and Daylight Rays in the Solar Cycle.—Dr. J. R. Ashworth . . 115
  Inverse Binomial Sampling.—Dr. R. A. M. Case . 115
  Geology of the Nubian Sandstone.—Dr. N. M. Shukri 116
  An Endodermal Phellogen in the Stem of *Paederia foetida* Linn.—Dr. P. Maheshwari . . . 116
  Synthesis of Adenosine Triphosphate by an Enzyme System from Ischæmic Muscle.—Marian Bielschowsky and Prof. H. N. Green 117
  Amœbiasis in Durban.—Major R. Elsdon-Dew . 118
  An Illusion of Size.—Prof. H. Hartridge, F.R.S. . 118
Colour Sensitivity of the Fovea Centralis. By E. N. Willmer and W. D. Wright 119
Ester Wax : a New Embedding Medium. By Dr. H. F. Steedman 121
The British Council 122
Some British Work on Nutrition. By Dr. G. Lapage . 123
Recent Scientific and Technical Books . . Supp. ii

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MORALE IN INDUSTRY

IN the subscription by people of all political parties in Britain to the policies of full employment and a rising standard of living, far too little has been said of some of the practical implications of these aims. There is indeed general agreement that total spending must be maintained at a high level, investment in industry scaled up, research encouraged, the quality of management improved and monopolistic restrictive practices rooted out. But it is rare to find any reference to another, and no less indispensable condition, both on economic grounds and by its bearing on the morale of the whole community: namely, the organization and incentives of industry must be so contrived that individual men and women produce as much as they can, putting no limit, conscious or unconscious, on reasonable maximum output. After five years of intense effort and overstrain, it is natural that everyone should look for shorter hours and increased leisure, but it is imperative to realize that in a world so short of consumption goods, houses, and utility services and amenities, the maximum output must be forthcoming during these shortened hours of work.

This is, in fact, part of the price to be paid for social security, but it is rare indeed to find the full implications of industrial efficiency, where they touch the worker himself, recognized; and the broadsheet "Output and the Worker" issued by P.E.P. expounds an aspect of the drive for full production which the dust of the general election in Britain has tended still further to conceal. The causes of limitation of output go deep and involve a complex of mental and physical factors. Lighting and ventilation, and other sources of physical comfort or discomfort, have an obvious effect on output; but the effect of mental factors such as the fear of unemployment and anxiety about pay may be equally important though less obvious.

The P.E.P. broadsheet, which is based on part of a forthcoming report on industrial relations, and compares the main findings of qualified investigators on this subject, suggests that security of employment alone would remove one of the main brakes on individual or group production. Again, it suggests that production committees, wisely handled, should go some way towards removing another mental obstacle to full production—the sense of antagonism between workers and management, arising from a real or supposed clash of interests. At the same time, by spreading a feeling of greater personal responsibility, these committees might help to mitigate industrial boredom, itself a potent source of restriction.

There is no simple cure for these and other mental causes of restriction, nor can the problem as a whole be tackled successfully by management alone. A joint approach by management and workers is required, and a reconciliation should be sought between their group interests. The broadsheet affords strong support for the view advanced by Prof. H. J. Laski in his "Reflexions on the Revolution of our Time", that with the achievement of a policy of full employment the trade unions may have new and more positive functions in place of those defensive and sometimes restrictive policies which they have pursued in the past.

The evidence reviewed by P.E.P. in this broadsheet covers experience in the United States, including that of M. E. Dickson, of Whiting Williams, of S. B. Matthewson and the prolonged researches at the Hawthorne Works of the Western Electric Co. in Chicago, as well as the work of S. Wyatt, H. M. Vernon and the well-known series of studies under the Industrial Health Research Board in Britain. Restriction in particular is closely analysed by S. B. Matthewson in "Restriction of Output Among Unorganised Workers", and more recently by F. J. Roethlisberger and W. J. Dickson in "Management and the Worker" (Harvard University Press, 1942).

The present P.E.P. broadsheet is concerned with what may be termed the predominantly mental sources of limitation of output, whether conscious or unconscious. Physical factors, such as lighting, heating, ventilation, humidity and noise may diminish or increase physical fatigue and so affect output. But while bad conditions in respect of any of these factors may reduce output severely, even if conditions are reasonably good further changes in the physical environment may have little effect by comparison with psychological factors which may mask any effect due to the physical factors. It is of course difficult to draw a firm distinction in practice between fatigue and boredom. Physical and mental factors in practice usually interact, and the brilliant investigations of the Industrial Health Research Board into the nature of industrial boredom and its effect on output, which as a result of the increasing importance of repetitive work in modern factory-production has become one of industry's most pressing problems, have indicated that the attitude to work is largely a group phenomenon. Working groups tend to have a predominating tone in this respect, and this tone frequently depends on one or two outstanding personalities, acting as more or less informal leaders to the group.

Similarly, it is difficult to distinguish conscious from unconscious elements, and unconscious or semi-unconscious limitation of output is probably more prevalent than deliberate, organized limitation. That factor in itself may well have had an important influence on the high level of output during the summer and autumn of 1940, and have masked to some extent the injurious effect of the excessive hours worked during a prolonged period in spite of all the evidence of the dangers of such a policy. Fear of unemployment undoubtedly ranks high among the causes limiting output, and so long as mass unemployment is allowed to occur, the widespread belief will persist that there is a definite limit to the amount of work to be done, and that it is therefore in the interest of wage-earners as a whole to share what work is available among as many people as possible. Such reasoning will not be rooted out by mere argument, and there have already been incidents in the transfer of labour from war-time employment which, to say the least, will not help such eradication.

Matters affecting payment, particularly fea rate-cutting, come next in importance; but w the case against economic factors as a main caus restrictive practices may possibly be over-stated Roethlisberger and Dickson, here as in boredom a matter of physical and mental factors interact Moreover, though a new machine or an improvem in technique could probably have more effect on duction than could any improvement in app industrial psychology, the absolute contribut which could come if we achieve the highest product potential of working individuals and groups is v great. In addition, when the majority of its memb are deliberately or unconsciously giving less th their best, a society is on a very unsound basis.

For these reasons, an improvement in industr morale stands only second in importance to impro ment in industrial technique and equipment. In sp of its defects in morale, industrial efficiency in Brit suffers more from lack of up-to-date equipment a organization than from lack of skill in its operative but as we replace obsolete methods and equipme and approach American standards, the importance morale will increase. Experience of the industrial w effort in Britain, the United States and the U.S.S. suggests that utilization of the group interest of t workers themselves is the most important line advance, and clearly offers great scope for c operation between management and trade union So long as there is a real or supposed gap between t group interests of workers and management, th enlisting of this source of productive energy w remain imperfect, and in spite of the valuable lesso to be learnt from the war-time joint productio committees, the scope of such bodies has yet to b worked out in its most effective form.

It must be recognized that there are genera features of the industrial situation, independent o trade unionism, which are of governing importance The total economic situation, as already emphasized profoundly affects the industrial psychology of the working individual or group. Again, mechanisms o defence which the average worker erects against the trade cycle and the attitude that goes with them persist even when not relevant in a given economic situation. Then there is a long-standing and deep seated suspicion of authority in all its forms, and particularly as seen in the supervising staff in immediate contact with the worker.

To these features the P.E.P. broadsheet makes no more than passing reference, although their importance is clearly stressed. The central difficulty, however, is nowhere stated in the broadsheet, for all the recognition of the value and the limitations of scientific research in this field. That difficulty is essentially the inevitable opposition which develops between the scientific approach to the human problems of production and the political approach of the administrator trained in the method of accommodation and compromise. The balancing of opinions and the compromise of different points of view, which is the essence of the political process, may be totally at odds with the scientific approach to questions of industrial management. What is required is not the render of scientific principles of accepted accuracy, the ignoring of established fact, but the combina- n or integration of both the political and the entific approach in a solution which satisfies both e scientific and the psychological or political quirements.

On our success in achieving such a solution, the estion of morale, industrial efficiency and ultimately full employment policy largely depend. The point uld scarcely have been made better than in the dress "Compromise and Integration" which Colonel Urwick delivered last February to a joint meeting Liverpool of the Institute of Labour Management d the Institute of Industrial Administration. The conciliation of our institutions to the new environ- ent created by science and technology is the great roblem of our civilization, and Colonel Urwick emonstrated effectively the challenge involved in sing fully the results of scientific knowledge and the mense control it gives us over material things, ithout sacrificing the freedom of mind which alone akes further scientific progress possible.

Not the least significant part of Colonel Urwick's ddress is the opening part, in which he stresses the eed for precise thinking and for exactness in the use f words. Words are the tools with which men think, nd scientific workers would be more effective in the nterpretation of their work to the community if they cept that axiom more constantly in mind. In any vent it must be regarded if we are to achieve the ntegration of scientific workers and technicians with each other, and of science and technology with the life of the community. A first step to the new kind of thinking, towards seeing our problems as a single problem, to the integration which will eliminate the confusion into which our civilization has fallen since the industrial revolution, is a clear understanding of the words we use as our tools of thought, and in particular of the distinction between compromise and integration. It is also the first step towards resolution of the conflict between social classes and between private ownership and State bureaucracy.

While a clear understanding of the terms used is a first essential, the light of a great common purpose alive and real in the minds of all the specialists as in that of the community they serve is equally important. Such a purpose must be conceived in terms of the common welfare, not in that of a particular class or section; and of its nature it implies the participation of all the people for its realization. Such participation in its turn demands not just that the experts understand each other, but that they make their specialized tasks explicit to the people, so that they are understood by and become real to them.

This is impossible, as Colonel Urwick points out, while men try to live their lives in water-tight compartments guided by mutually incompatible principles. We must, he reminds us, restate our philosophy of economic life in terms which can give both specialists and workers a sense of common moral purpose. To do this, to integrate the real wishes of the right and of the left in Britain, we need vision and determination to cut through the verbal formulations, the truculent attitudes, and the clinging to outworn slogans in which those wishes are disguised. Our national spirit of accommodation and conciliation should be exercised in making conflict really constructive, and in inventing and developing true integrations.

The significance of all this in industrial psychology and in management generally, and the challenge offered to constructive thought by the present situation, should need no further emphasis for the scientific worker. But if industrial efficiency and the achievement of the maximum output require a closer integration of the workers and of the management, equally they require a closer integration of industry itself with the needs and purposes of the community as a whole. That will not be achieved merely by scientific research in the field of industrial health and psychology, by the establishment of the most effective conditions for joint production committees, and so on. It is part of the larger task of establishing the dynamic relations between individuals and the organizations they serve in the nation as a whole which really represents what we understand by the term 'morale'. For this we need to call on the civic idealism and spirit of service which the Fighting Forces have already generated in youth. In the schemes for education in citizenship, study circles, discussion and community groups, supported by such national services as the Arts Council of Great Britain, and possibly a national fellowship of service as suggested by Mr. Arthur Bryant, we may be able to elaborate machinery through which democracy can function on the ground-level, and the spirit of accommodation and reason be fostered as against an uncompromising attitude which is so grave a danger to industrial efficiency and to the existence of democracy. Ultimately, industrial efficiency depends on the integration of the purposes of industry with those of the community itself; and for the smooth functioning of our co-operative institutions, whether industrial, professional or cultural, the preservation of their social values, and the establishment of dynamic relations with the community they serve, not merely technical knowledge but also the skilled diagnosis of human situations are vital factors.

TROPICAL PEDOLOGY

The Soils of Equatorial Regions

With Special Reference to the Netherlands East Indies. By Prof. Dr. E. C. Jul. Mohr. Translated from the Nederlandsch by Robert L. Pendleton. Pp. xii+766. (Ann Arbor, Mich.: Edwards Brothers, Inc.; London: H. K. Lewis and Co., Ltd., 1944.) 7.50 dollars.

THE study of soils in equatorial or tropical countries has been very backward in comparison with that in temperate regions in spite of the great development of agriculture in the low latitudes. What is known is largely due to agricultural officers and chemists who had little time to spare from their routine duties. Unfortunately, much of the information available is for surface soils only, profile studies being rather scarce. Comprehensive studies on tropical soils are thus rare, and one turns with interest to the volume under review for enlightenment on the many pedological problems provided by these soils.

The book begins with an extensive description, with chemical analyses, of most of the rock types occurring in the Netherlands East Indies. The second chapter passes naturally to a consideration of "the active forces of soil formation", that is, climate, both atmospheric and soil. Chapter 3 is devoted to a discussion of the processes of weathering and soil development. The remainder of the volume consists of descriptions of the geology, soils and agriculture of the islands composing the Netherlands East Indies.

In 1930 Dr. Pendleton first made available in English Dr. Mohr's theories of tropical soil development, to which little attention has been paid by soil workers. In a way, this is not surprising, for the symbolic method used by Mohr for soil description is repellent at first sight; for example, one soil discussed has the following designation

$$V(a + b) . (1 + 2) - Ma.NN.ae.3.$$

The various factors represented in this notation and which form the basis of the discussion are parent material, temperature zone, water movement in the soil, whether weathering is aerobic or anaerobic, and finally the stage in the developmental series. In illustration we may give briefly Mohr's conception of the formation of a laterite soil from a basic volcanic ash in tropical lowland; the soil sequence is symbolized as $V.b.1 - He.NN.ae.$ (1–5). The first stage is the leaching of bases and silica, the latter precipitating at depth to form a tuff which gradually leads to the development of a perched water-table. From the upper layers silica continues to be lost and soon kaolin follows, leaving behind iron oxides, alumina and quartz. The iron oxide gradually ages and the colour of the soil changes through yellowish brown to red, with mottling in the lower parts. Within the water-table the iron rises and is deposited in the form of a pan or crust when it comes in contact with air. This results in its separation from the kaolin. The water-level is gradually raised, the ferrugmous layer is moved upwards and the kaolin layer becomes thicker. Eventually the eluvial layer becomes impoverished of silica and kaolin and there is then a differentiation of the iron and aluminium into two layers, the aluminous one being the lower. With soil impoverishment the soil vegetation deteriorates and erosion increases so that the ferruginous layer becomes exposed as a crust. At higher elevations the whole process is much slower and erosion so much greater that if red earths are found, it is assumed that they are really fossil, having been formed near sea-level and afterwards raised to their present position by tectonic movements.

Mohr's analysis of the development of a laterite soil is similar to that given by Campbell in 1917. Later, on the basis of his studies in the Amazon Basin and Cuba, Marbut (1930) showed this particular soil to be a type owing its existence to a high ground water-table, and not at all typical of well-drained sites. From Mohr's account one gets the impression that this ground-water type is the only one occurring in the Netherland East Indies, but since well-drained laterite soils with no ferruginous horizon as visualized by Mohr have been repeatedly described in the Far East (China, Ceylon, the Philippines) it would be strange if none occurred in these islands.

Although the scheme is worked out in detail o for volcanic ash deposits, it should be applical perhaps with minor modifications, to soil devel ment on other rocks, for example, granites, gabbr etc. From Mohr's own descriptions it is quite i possible to tell to what extent it does really app The sole criterion used in later parts of the book i establishing the stage of development seems to the colour of the eluvial layer, that is, whether it grey, yellow or red. The nature of the parent materi of course, does affect the rate of development a Mohr states that basic igneous rocks give redo 'lixivia' than granites, which tend to give yellow 'lixivia' although they may become red. Develc mental series similar to the above example are al worked out for other parent materials, such as ma and limestones, and for other drainage conditio for example,[1] impeded and imperfect, the associat soil types including black earths and terra rossa.

The principal value of Mohr's method of classific tion is that it emphasizes the idea of development sequence which is too often ignored in soil studie It may thus provide a clue to the interrelationsh of the red and yellow lateritic earths which are bot quite well established now, but the position of whic in the general scheme of soil classification is not y clear.

The part played by organic matter in tropical so formation is given great prominence and the proble of erosion is fully discussed. In the discussion (erosion, Mohr emphasizes the effect of the differen forms of hydrous iron oxide on erodability of soil In the colloidal state there is mutual flocculatio between the iron oxide and clay and organic matte resulting in a pervious system. When, however, th iron oxide is more highly crystalline (gœthite o hæmatite) it does not have a flocculating effect o the clay. When the latter "is poor in bases it i excessively dispersed hence impervious to air and water". Thus juvenile brown earth is pervious, but when saturated with water quite easily erodable. Senile red earth is more difficultly permeable and is less subject to washing off. With alumina the theory is similar. Thus, soils with a low silica-sesquioxide ratio, that is, soils of the warm humid regions, are non-erosive if iron oxide occurs in one or other of the red forms. With regard to the relatively high values reported for organic matter in red and yellow tropical soils, Mohr doubts their accuracy, and suggests that they may be due to carbon dioxide adsorbed on the abundant hydrous iron oxide present in the soils and not to organic matter.

In the second part of the book, a section is devoted to each of the islands or territories under Dutch control. The material in each section includes a brief discussion of the geology, weathering conditions and soil formation, finishing with a description of the agriculture in relation to soils. This part will be of greater interest to agriculturists concerned with tropical crops, and it seems to give a good account of the various practices, with suggestions for improvement.

From the pedological point of view, the main weakness of the book is the virtually complete lack of either adequate profile descriptions or chemical analyses which might substantiate Dr. Mohr's theories. Any theory of tropical soil development must take into cognizance available data from other countries, and this Dr. Mohr has failed to do. There is no reference to the work of Hardy in Trinidad, Joachim in Ceylon, Martin and Doyne in West Africa, American studies in the Caribbean and Pacific ions, although Harrassowitz comes in for strong ticism. The book also suffers somewhat from the t that its original production was protracted 33–38), so that one finds in the earlier part, for ample, that 'kaolin' is the main component of e clay of the various soils, while in later sections ontmorillonite' takes its place in discussions of e black earths and terra rossa. There are many her points on which the book might be criticized, t this would be unfair since the author was unable complete the projected revision for the English ition.

Dr. Pendleton has made an excellent translation der considerable difficulties, and the book is well istrated and beautifully produced; but I would ich rather have seen an account of tropical soil mation by Dr. Pendleton himself, for few soil rkers have had such a long and varied experience these soils.

A. MUIR.

STUDY OF EARTHQUAKES

eismology
y Perry Byerly. (Prentice-Hall Geology Series.) p. x+256. (New York: Prentice-Hall Inc., 1942.) .65 dollars.

THIS book about earthquakes and their study, by an eminent American professor, living in a tate occasionally visited by strong earthquakes, and eaching seismology in a university which introduced he subject to the United States, is a valuable, important and welcome addition to international eismological literature. The book is divided into wo parts. The first seven chapters, Part 1, are on he subject of earthquakes and require little technical nowledge. Part 2, entitled seismography, preupposes readers with some preparation in mathematics and physics.

Many perfectly general problems in seismology have already been solved. Excellent summaries of the main theories of earthquake causes at present tenable are given in Chapter 4, while many others have been discarded as quantitatively unreasonable. The author admirably stresses the living nature of the subject and often the reader's imagination is kept alive, and his feet on solid unshaking rock, by queries about the theories (pp. 50–51). A start only has been made with the details of seismology; for example, Prof. B. Gutenberg and others have discovered local variations in the travel-time tables (pp. 210–14) and thus have suggested answers to geophysical questions concerning mountain roots—and the subject bristles with topics for research. Not one of the theories listed in Chapter 4 will enable one to decide in advance the exact focus and time of occurrence of a shock, and it is just these things which engineers and public authorities wish to know if they are to take all precautions for public safety. Can instruments be devised to detect variations in critical material deep underground such as accumulating pressure or variations in temperature and plasticity? It is to details such as sudden changes in these and like functions to which we must look. There are also minor discrepancies in seismology to clear up, such as the differences occasionally met with between mathematically determined epicentres (from readings of seismograms) and the same epicentres determined geologically in the field (p. 26). The old problem, however, of distinguishing cause and effect as between earthquake and geological fault is considered solved by Prof. Byerly, who says (p. 26), "On the whole it seems reasonable in our present state of knowledge to assign *faulting* as the *cause* of all large earthquakes and almost all small ones". A four-figure number is suggested for each earthquake, each successive figure denoting intensity, greatest perceptible distance, lives lost, and damage to property. Such a number would describe the shock in greater detail than the present Modified Mercalli Scale number only. Such suggestions are extremely important in areas comparable with California, where an extensive programme of research is carried out by the United States Coast and Geodetic Survey with the co-operation of thousands of observers.

It is well known that world maps on which are placed dots for earthquake epicentres show definite lanes within which most of the earth's recent earthquakes have occurred. Most seismologists wish to show more than this in a manner which is as little complicated as possible. From time to time various suggestions have been made as to what else to include. Such quantities as intensity and depth of focus have been mentioned, but Prof. Byerly prefers 'seismicity' which includes area shaken, intensity and frequency. This he evaluates for areas in California (map p. 86). Part 1 ends with some new material on a few of the world's great earthquakes.

Part 2 opens with an excellent chapter of forty-eight pages on the mathematical theory of modern seismographs. Most of this space is given to the derivation of the fundamental equations of motion. The operational method for the solution of differential equations is first used to obtain the general equation of the response of a seismograph to an earth acceleration Φ. Free pendulums and damped pendulums are then examined with particular types of Φ. The determination of the constants and the dynamic magnification are dealt with, as is also electromagnetic registration for such as the Galitzin type seismograph. Some notes are given on the Benioff type in which an iron core or armature is used with the coil, on types of suspension and on methods of recording and damping.

Very little space is devoted to the all-important subject of time-keeping, though perhaps it is thought that this deserves a volume to itself. The mathematical theory of elastic waves is covered in twenty-six pages. General equations of motion, waves, reflexion and refraction, Rayleigh and Love waves are examined, and there is a paragraph concerning observations on surface waves. Paths of waves and travel-time curves are dealt with first mathematically in an idealized way and then practically and observationally. There follows naturally a short chapter on the location of epicentres by instrumental methods. The last chapter, on seismograms, covers in a masterly way modern trends from the shaking table experiments of K. Dyk and the analysis of seismograms by integration to the idealized mathematical work on the dispersion of Love and Rayleigh waves.

In so short a book for so wide a field one feels that the author must have had some anxious times pondering what to leave out. Not all topics have been touched upon, and the lists of references at the ends of the chapters have omissions even in the topics discussed in the chapter. It may still be true that there is no royal road to learning, but this book will undoubtedly form a good and sound though limited 'air landing strip in the kingdom of seismology'. From this strip the applied mathematician or mathematical physicist could easily range the seismological field and find suitable targets for attack with his mathematical weapons. The book would be most useful to university teachers of these subjects who are in search of problems for their advanced and research students. In this case chapter 1 and part of chapter 2 could be omitted.

The format is very pleasing and the printing is bold. The line diagrams are good but the reproduction of the photographic illustrations might be improved in a later edition. There is an adequate index.

E. TILLOTSON.

TEACHING OF PHARMACOGNOSY

A Text-Book of Pharmacognosy

By George Edward Trease. Fourth edition revised with the assistance of Dr. H. E. Street and E. O'F. Walsh, with Contributions by Dr. R. Bienfang, H. M. Hirst, H. O. Meek and A. H Ware. Pp. viii+800. (London : Baillière, Tindall and Cox, 1945.) 27*s.* 6*d.*

MR. TREASE can justly claim to be one of the foremost exponents of pharmacognosy in Britain. His work at Nottingham is well known, where he is head of the Department of Pharmacy and responsible for the teaching of pharmacognosy. He is also an examiner in this subject for the Pharmaceutical Society and for the University of London.

Teachers and students will welcome this fourth edition of an already well-used text-book, and those familiar with the previous editions will readily recognize the improvement brought about by a complete revision of the subject-matter. Mr. Trease has gone to considerable pains to incorporate, up to the time of writing, the results of recent research, and also the material the use of which in medicine has been permitted owing to the exigencies of war. The result is a volume packed with useful information presented in an attractive manner and profusely illustrated.

One of the major alterations is the extension of the chapter on cell-structure. To his credit, Mr. Trease has not hesitated to draw upon those who have special knowledge of different aspects of his subject. A good working knowledge of plant histology is essential to success in the higher branches of pharmacognosy, where microscopy is so important in the identification of drugs in powder form. Many students have to approach it equipped only with the botanical training of the standard required for the Pharmaceutical Society's Intermediate Examination. Such students do not extend their knowledge of plant structure in further botanical work except as afforded by pharmacognosy. Teachers of this subject are therefore compelled to devote considerable time to plant histology. Therefore Dr. Street's account of cell-structure, and his well-executed drawings illustrating various types commonly met with, will be much appreciated.

It is questionable whether, with his limited botanical knowledge, the student can appreciate the arrangement of the official drugs of vegetable origin according to the systematic classification of plants. For teaching purposes it appears to be more convenient to classify the drugs themselves according to their morphological nature. Such arrangement enables the student to compare and contrast similar organs both macro- and microscopically and to member more easily the points of difference diagnostic purposes. One advantage of the pres arrangement is to emphasize that similarity of che ical constituents in drugs does not necessarily im close phylogenetic relationship.

The publishers are to be congratulated on hav been able to produce a work of this magnitu relatively free from errors, under war-time restrictio of labour and materials.

W. O. HOWARTH.

ADVANCED ORGANIC CHEMISTR

Organic Chemistry

By Louis F. Fieser and Mary Fieser. Pp. xii+10 (Boston : D. C. Heath and Co., London : George Harrap and Co., Ltd., 1944.) 30*s.*

WITHIN the limits of this treatment the auth have undertaken a survey of the vast field organic chemistry at the level of students readi for an honours degree in the subject. This ambitio project has been carried through with conspicuo success in a single volume of forty chapters and little more than a thousand pages. The book written in a clear and easy style, flowing natural from one topic to the next. The dual authorship so effective that it shows little sign of the numero joints indicated in the preface ; nor would the read suspect, apart from the statement in the same plac that a large part of the writing of the senior auth was done "in trains, planes, hotels, and army cam in the course of more than one hundred trips".

Starting with hydrocarbons and alcohols, th account leads through other common aliphatic type to Chapter 11 on stereochemistry. Following thi chapters on ring formation, rubber, carbohydrate fats and waxes, and proteins, are succeeded b specialized reviews of microbiological processes, th role of carbohydrates in biological processes, and th metabolism of fats, proteins and amino acids. Th next thirteen chapters are devoted to aromati chemistry, and the work ends with further chapters o dyes, synthetic fibres, synthetic plastics and resins steroids, isoprenoid compounds, accessory dietar factors, and advances in chemotherapy.

The work affords a valuable and up-to-date treatment of organic chemistry, in which due stress is laid on technological, biological and medical aspects of the subject. Modern theories of organic chemistry are well developed as the book unfolds, and this object has been achieved unobtrusively without an undue display of electronic symbolism to delay the narrative or obfuscate the reader. The text is well documented with a list of reading references at the end of each chapter ; there is a good index ; and the letterpress, diagrams and formulæ are admirably printed. An unusual feature is the statement of the yields obtainable in many of the reactions quoted. With so much to applaud, it would perhaps seem ungracious to suggest that more space could have been allocated to one specific theme at the expense of another—as, for example, to terpenes at the expense of aromatics—but it is difficult to advance any other criticism of moment. Taking it all in all, this work provides one of the best surveys of organic chemistry to be produced in recent years for advanced students of the subject, and it is bound to achieve popularity among this overburdened section of the modern community.

JOHN READ.

LUBRICATION OF METAL SURFACES BY FATTY ACIDS

By Dr. F. P. BOWDEN, J. N. GREGORY
AND
Dr. D. TABOR
ouncil for Scientific and Industrial Research, University, Melbourne

WHEN surfaces in relative motion are separated by a fluid layer of appreciable thickness, the sistance to motion is due to the viscosity of the terposed layer. This type of lubrication is essentially problem in hydrodynamics; the friction is very nall and there is no wear of the moving surfaces. is clear, however, that in many practical cases uid lubrication is impossible. In many sliding echanisms, or at the beginning and end of a ciprocating stroke, it is difficult for a thick conuous film of lubricant to be maintained, and even rotating parts the thick film may break down and ly a thin film of lubricant may remain. In such ases the friction is influenced by the nature of the nderlying surfaces as well as the chemical conitution of the lubricant, and Hardy referred to such state as 'boundary lubrication'. Boundary lubricaion is of great importance in practice, and the nature f the surface film will determine whether serious wear or seizure will take place. The coefficient of riction for really clean metals which have been outgassed in a good vacuum is high and may be[1] about $\mu = 6$. For ordinary unlubricated metal surfaces which are exposed to the air the coefficient of friction s of the order of $\mu = 0{\cdot}5$–1. For metal surfaces ubricated with a boundary film μ is about 0·05–0·15. This is considerably less than for clean surfaces, but s much higher than for fluid lubrication.

Effect of Chain Length

A systematic investigation of boundary lubrication was first undertaken by Hardy[2], who measured the static friction between surfaces, using homologous series of paraffins, fatty acids and alcohols as the lubricants. Using simple apparatus, he found that the coefficient of static friction decreased linearly with the chain-length of each family of compounds. The friction also depended on the nature of the underlying solid surfaces. He was thus able to show that the friction was a function of separate contributions by the solid surfaces, the chemical series to which the lubricant belonged and the number of carbon atoms in the chain.

Hardy explained these results by a very simple and elegant theory. He assumed that the friction between unlubricated surfaces is due to the surface fields of force. When the lubricant is added, the lubricant molecules orientate themselves at each of the solid surfaces to form a unimolecular adsorbed film. The solids sink through the lubricant layer until they are separated by only the unimolecular adsorbed film of lubricant. Slip then takes place between these adsorbed films, and the efficiency of a boundary lubricant is measured by the extent to which these films can mask the fields of force of the underlying surfaces. Along these lines Hardy was able to explain the linear relationship observed between the friction and the molecular weight for different members of a homologous series.

Later workers on static friction have not, however, fully confirmed these results[3]. Measurements of *kinetic* friction[4] also show that for a given homologous series there is no linear relation between friction and chain-length, but a fairly rapid decrease in the coefficient of friction, μ, to a constant value of about 0·1 as the chain-length increases. With fatty acids this steady value of μ is reached for steel surfaces when the molecular weight exceeds about 100, and for glass surfaces when the molecular weight exceeds about 200.

If the friction is measured with an apparatus in which one of the sliding surfaces possesses an appreciable degree of elastic freedom, the motion may not be continuous but may proceed in a series of jerks. There is an intermittent clutching and breaking away of the surfaces, and the friction, surface temperature, and the area of contact all show violent fluctuations. The nature and extent of these fluctuations naturally depend upon the elastic and mechanical properties of the system, but for given conditions the nature of the motion is profoundly influenced by the nature of the surfaces themselves[5]. With unlubricated metals and other solids, the surfaces are always torn to an appreciable extent and it is clear that the friction cannot be regarded entirely as a surface effect, but must be closely dependent upon the bulk properties of the solids. With mineral oils and many other lubricants the friction is lower, but the behaviour may still be essentially the same as for unlubricated metals. The intermittent clutching and breaking away still occurs through the lubricant films, and marked wear of the surface may still occur. Certain substances, however, are able to prevent this 'stick-slip' motion and allow smooth sliding to take place.

This type of measurement may be used to demonstrate in a striking way the effect of the chain-length of the lubricant. With short-chain fatty acids, for example, the motion proceeds in 'stick-slips' and some wear takes place. When the chain reaches a certain length, smooth sliding occurs, the friction falls and the wear is appreciably reduced. With steel surfaces the transition from intermittent motion to smooth sliding occurs at a chain-length of 5 or 6 carbon atoms, that is, a molecular weight of about 100.

Film Thickness

Langmuir and Schaefer[6] were the first to show that a monolayer of a fatty acid deposited from the Langmuir trough is sufficient to reduce the friction of glass surfaces from about $\mu = 1{\cdot}0$ for clean glass to about $\mu = 0{\cdot}1$. Bowden and Leben[7], working on built-up films varying from 1 to 53 molecular layers, obtained similar results. A monolayer of stearic acid on steel produced the same low coefficient of friction as a multilayer 53 molecules thick. However, the single film was soon worn away, and for effective lubrication capable of withstanding considerable wear it was found necessary to have present a layer of lubricant several molecules thick in order to replenish the surface with fresh lubricant. These experiments also showed that even with the thickest molecular films a certain amount of wear of the metal surfaces takes place. The importance of the first monolayer has also been substantiated by other workers[6,8,9,10].

These experiments were carried out on films deposited on the metal from a surface of tap water, and they may really consist of the calcium soap rather than the fatty acid. A direct estimate of the thickness of the lubricant film may be made in another way. In some recent experiments a known quantity of 0·01 per cent lauric acid in paraffin oil was placed on a clean cadmium surface, and gave effective lubrication. The area covered by the oil was increased until the newly covered regions gave poor lubrication. From these observations it was possible to calculate the amount of lauric acid which was just sufficient to give good lubrication. It was again found that the lubricating film was of the order of 1–2 molecules thick.

With some metals, however, a monolayer of fatty acid is insufficient to provide adequate lubrication even for a single run. This falls in line with the earlier observations[1] on the friction of clean outgassed metals. In the absence of all surface films the friction was very high. With outgassed gold the admission of a trace of fatty acid vapour to the surfaces produced a decrease in friction which grew more marked with time as a thicker lubricating film formed on the surfaces. Similar results were obtained when a trace of oxygen was admitted to the surface of clean outgassed nickel, copper and gold.

It is evident, therefore, that in the lubrication of metals by fatty acids, the first adsorbed layer is, in many cases, responsible for the lubrication observed. This single layer is usually unable to provide adequate protection for the continuous traversals of the same track; for efficient lubrication in such cases an excess of fatty acid must be present to repair the damage caused by sliding. For some metals, however, a single layer is not sufficient to give adequate boundary lubrication even for the first run; a relatively thick film is necessary.

Effect of Temperature

The effect of temperature on the lubricating properties of boundary lubricants is of general interest and importance. In many parts of an engine, high temperatures may be reached in the running parts, and it is necessary to know the way in which this will affect the lubricant. For temperatures above 200° C. the main effect on a mineral oil is that of oxidation[11]. A mineral oil at room temperature will give stick-slip motion and appreciable wear. After heating for some time, the oil may develop oxidation products which will be adsorbed at the metal surface and will improve its lubricating properties; the oxidized oil will now give smooth sliding and reduce the wear. These changes are not reversible on cooling and are due to chemical changes in the oils (and sometimes the surfaces themselves). At higher temperatures after prolonged heating, gumming, corrosion and the production of other deleterious products will cause a deterioration in the lubricating properties.

A very different type of frictional change which is reversible may occur at lower temperatures[12]. For example, a typical 'high quality' commercial lubricant on a steel surface will give smooth sliding and slight wear. On warming the steel surface to 70° C., the motion changes from continuous sliding to stick-slips; on raising the temperature further, the stick-slips increase in size, the friction rises and a corresponding increase in wear takes place. Provided the heating has not been sufficient to cause appreciable oxidation of the lubricant, these changes are completely reversible on cooling. This effect has been investigated for pure substances[7]. For pure paraffins and straight-chain alcohols the transition occurs at the bulk melting point of the compound. For the substances the transition temperature is sharp a clearly defined.

With fatty acids the transition temperature depends upon the load, speed and the experimen conditions, but it is considerably *higher* than the bu melting point of the fatty acid. Under the conditio of measurement used by Frewing and Tabor, T f fatty acids on steel was about 70° C. above the bu melting point. Under the different experimen conditions which obtained in Hughes and Whittin ham's experiments[8], T was about 30° C. higher th the melting point. These workers also showed th the frictional properties and transition temperatu of fatty acids deposited as a monolayer, or as monolayer covered with paraffin oil, or as acid bulk, are essentially the same. These results aga show that the first monolayer is responsible for t lubricating properties of the lubricant and for t phenomenon associated with the measurements of

Nature of the Underlying Surfaces

Little work of a consistent nature has been carri out on the effect of the underlying metal on th lubricating properties of given lubricants. Har made some comparative measurements of the c efficient of static friction μ_s on steel, glass ar bismuth surfaces and found that for any give hydrocarbon, fatty acid or alcohol, μ_s for glass is le than μ_s for steel, which is less than μ_s for bismut Sameshima carried out some similar experiments o steel, glass and silver surfaces. He found that gla was poorly lubricated, whereas steel was well lubr cated, by fatty acids and alcohols. Silver showed a intermediate behaviour.

A more systematic investigation has been describe by Hughes and Whittingham[8], who compared th lubricating properties of stearic acid and a com mercial oil on various metal surfaces. They showe that for the commercial oil the value of T was ver dependent on the nature of the metal substrate. Fo stearic acid, however, they found that both μ and were not greatly dependent on the nature of th substrate whether it was of silver, lead, tin, alum inium, cast iron, stainless steel, copper or even coppe oxide or copper sulphide. In these experiments however, they used an upper slider of a fixed meta throughout (steel). This clearly introduced an un certainty into the interpretation of the results.

A series of experiments has recently been carrie out using similar metals for both the upper and th lower surfaces. The lower surface was a flat plat and the slider was hemispherical. Comparativel heavy loads of approximately 4,000 gm. were use and the sliding speeds were slow, c. 0·01 cm./sec The results show that the lubricating properties o the fatty acids depend very markedly upon th nature of the metal. One of the most striking result is that, for unreactive surfaces such as nickel platinum, silver and glass, fatty acids are scarcely more effective as lubricants than saturated hydro carbons. These results led to some measurements o the chemical reactivity of the various surfaces wit fatty acids under standard conditions. Lauric ac was used and the metal surface heated up to 150° C. with the acid in contact with it. The results at once showed that the metals fall into two distinct classes: (*a*) in which chemical attack is absent or is barely detectable; and (*b*) those for which chemical attack is marked (see table).

FICIENCY OF LUBRICATION WITH 1 PER CENT LAURIC ACID IN PARAFFIN COMPARED WITH REACTIVITY OF THE METAL TO LAURIC ACID.

Metal	Coefficient of friction (20° C.)	Transition temperature (° C.)	% Acid* reacting	Type of sliding at 20° C.
Zinc	0·04	94	10·0	Smooth
Cadmium	0 05	103	9·3	"
Copper	0 10	97	4·6	"
Magnesium	0·10	80	Trace	"
Iron	0·15–0 20	*c.* 40–50	"	Irregular (smooth)
Platinum	0·25	20	0·0	Stick-slip
Nickel	0·28	20	0·0	"
Aluminium	0 30	20	0·0	"
Chromium	0·34	20	Trace	"
Glass	0·3–0·4	20	0·0	Stick-slip (irregular)
Silver	0·55	20	0·0	Stick-slip (large)

* Estimated amount of acid involved in the reaction assuming mation of a normal salt.

As silver, copper and platinum are the only metals at are electropositive to hydrogen, the absence of action in the other metals must be due to the esence of a relatively stable oxide film. This is pported by some observations on aluminium. If e surface layer was scraped off so that the freshly xposed metal came in contact with the fatty acid, fective lubrication occurred. Where reaction occurs is probable that it occurs mainly in two stages:) the atmospheric oxidation of the metal, (2) re-ction of oxide with the acid. This has been con-rmed by Dubrisay[13] in his experiments on the orrosion of metals by solutions of fatty acids in ydrocarbons. It is apparent, therefore, that the ajor factor in determining the reactivity is not the osition of the metal in the electrochemical series ut the reactivity of the oxide film and its rate of eformation.

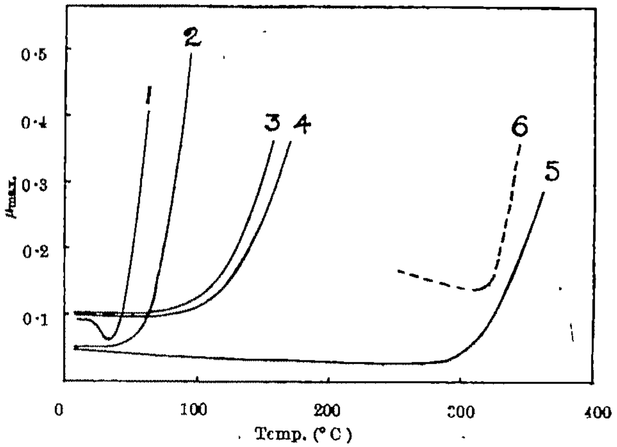
It is not suggested that there is a simple quantita-ive correlation between the coefficient of friction nd the reactivity of the surfaces, but it is clear that hose metals which are most effectively lubricated re also those which are most readily attacked hemically by the fatty acid. On the other hand, the unreactive metals and glass are poorly lubricated and give stick-slip motion with relatively high coefficient of friction. Further experiments showed that the less reactive metals, such as iron and aluminium, require a high concentration of lauric acid for the best lubrication. The unreactive metals, however, are not lubricated well even by pure acids unless the acids are solid. The lubrication of chromium and silver is of some practical importance at the present time, and it is interesting to note that neither of these is effectively lubricated by fatty acids.

Lubricating Properties of Metal Soaps

These results show that, under these conditions of sliding, the fatty acids themselves are only effective as lubricants when they react with the surfaces concerned. That is to say, lubrication is effected, not by the fatty acid itself, but by the metallic soap formed as a result of chemical reaction between the metal and the fatty acid. (It is interesting to note that an ester such as ethyl stearate does not lubricate above its bulk melting point on copper and cadmium surfaces. The behaviour on steel, however, appears to be anomalous and is the subject of a further investigation.) This view has been confirmed by several experiments on the lubricating properties of metal soaps. For example, a solution of copper laurate in paraffin oil gives the same frictional properties and transition temperature on copper as a dilute solution of lauric acid in paraffin oil. Further, the transition temperature (about 100° C.) is close to the temperature at which copper laurate begins to soften[14]. In this connexion it is interesting to recall the electron diffraction experiments of Tanaka[15], who found that stearic acid (m.p. 69° C.) on copper loses its high degree of lateral orientation between 120° and 130° C. Similar results for stearic acid on steel have been observed by Beeck, Givens and Smith[16]. More recently, Mr. A. Cowley has carried out some similar (unpublished) experiments with palmitic acid. He finds that a monolayer of palmitic acid (m.p. 62° C.) on cadmium loses its characteristic orientation at about 110° C. Monolayers of cadmium palmitate show exactly the same behaviour on both cadmium and platinum substrates. The softening temperature of cadmium palmitate is approximately 110° C. and frictional measurements show a breakdown at about the same temperature.

Similar behaviour is observed in the lubrication of platinum surfaces by metal soaps. Pure lauric acid, or lauric acid in paraffin, will not lubricate platinum at temperatures above 43° C., which is the melting point of the acid. If copper laurate is deposited from an ethereal solution on a platinum surface, the surface is lubricated up to temperatures of about 100° C., that is, the transition occurs at approximately the same temperature as that observed with lauric acid on copper. If, however, a solution of copper laurate in paraffin is applied to a platinum surface, the breakdown occurs at a much lower temperature and this must be attributed to the increased solubility of the metal soap in the paraffin. It is apparent that the breakdown of the lubricant film may be due either to a direct loss of rigidity by thermal softening or to a dissolution into the superincumbent liquid.

The importance of the physical properties and texture of the lubricating film is shown by experiments on sodium stearate applied to steel surfaces. If the soap is applied as a wet smear, breakdown occurs around 100° C. and is attributable to the ebullition of the excess water which disrupts the lubricating layer. If, however, the soap is applied



EFFECT OF TEMPERATURE ON FRICTION.

1. Solid docosane (m.p. 43° C.) on platinum surfaces. 2. Solid stearic acid (m.p. 69° C.) on platinum surfaces. 3. Solid copper laurate (softening point 110° C.) on platinum surfaces. 4. 1 per cent lauric acid in paraffin oil on copper surfaces. 5. 'Dry' film of sodium stearate (softening point 290° C.) on steel surfaces. 6. Thin film of lead (m.p. 327° C.) on hard steel surfaces.

from an ethereal solution, it retains its lubricating properties up to 300° C., which corresponds to the temperature at which sodium stearate softens and becomes a mobile liquid[14]. The behaviour of long-chain fatty acids on unreactive surfaces is thus similar to that of long-chain hydrocarbons, and to that of thin films of soft metals deposited on hard substrates which lubricate until the melting point of the film is reached. This behaviour again is similar to that of metallic soaps which, as pointed out above, maintain their lubricating properties until the temperature reaches the softening point of the soap. These similarities are shown in the accompanying graph, where it is seen that docosane (m.p. 44° C.) and stearic acid (m.p. 69° C.) lubricate platinum surfaces until they melt; a thin film of lead (m.p. 327° C.) lubricates steel until the melting point of the lead film is reached; sodium stearate lubricates steel until the stearate softens and melts (about 300° C.). Finally, lauric acid in paraffin lubricates copper until the softening point of copper laurate is reached (about 100° C.).

Mechanism of Boundary Lubrication

All our experiments have shown that even with the best boundary lubricants and comparatively light loads, there is some wear and damage of the metal surfaces. The underlying metal is, in fact, torn to a depth which is large compared with the dimensions of a molecule. A large part of the surface may show little sign of damage but, at various localized points of contact, there are definite signs of metallic adhesion through the lubricant film and minute fragments of one metal may be left welded on to the other[17,18,19]. This means that the friction of lubricated metals cannot, in general, be due simply to the sliding of one monolayer over the other; nor, indeed, can it be merely a function of the surface forces as Hardy supposed. It must be greatly influenced by the bulk properties of the metals concerned.

It has been shown that for unlubricated metals the frictional resistance F can be conveniently written

$$F = S + P,$$

where S is the force required to shear the metallic junctions formed at the points of contact and P is a ploughing term. Under some conditions the ploughing term may be small, and if this is neglected,

$$F = S = As,$$

where A is the real area of contact between the metals and s is the shear strength of the junctions. With clean metals the welding is strong, so that the break frequently occurs within the metal itself. In this case s will be equal to the shear strength of the metal. An effective lubricant will diminish the area of metallic contact although, as we have seen, it is rarely able to prevent it altogether.

When lubricated metal surfaces are placed in contact, plastic flow of the metals occurs until the area is large enough to support the applied load. The pressure, however, will not be uniform over the whole region of contact. At some points it will be very much higher, and at these points a local breakdown of the lubricant film may occur. The extent of the breakdown will naturally depend on the nature of the lubricant film. Further, if the sliding speeds are appreciable, it will be aided by local high temperatures developed during sliding. As a result of the partial breakdown of the lubricant film, metallic junctions, large compared with the size of a molecu are formed between the surfaces. The resistance motion is then due largely to the force necessary break these junctions. There will also be so resistance to sliding by the lubricant film itself, a we may write

$$F = A(\alpha s_m + (1-\alpha)s),$$

where A is the area which supports the applied loa α is the fraction of this area over which breakdow of the film has occurred, s_m is the shear strength the junctions at the metal-metal contact, and s the shear strength of the lubricating film. Wi a good lubricant the area over which metallic co tact occurs may be very small indeed. Neverthele the shear strength of these junctions may be so hig compared with that of the lubricant that they ma be responsible for the greater part of the resistan to motion.

The main purpose of the lubricant film is, ther fore, to reduce the amount of metallic conta between the surfaces by interposing a layer that not easily penetrated and that possesses a relativel low shear strength. In order to prevent appreciab contact, the lubricating layer must, in addition t being firmly attached to the surface, possess a stron lateral adhesion between the hydrocarbon chains. I the film softens or melts, that is, if the lateral adhesio between the chains falls to a low value, metalli seizure occurs with a corresponding increase i friction and wear. The fact that *solid* films o saturated hydrocarbons are more effective in lubri cating unreactive metals than fatty acids above thei melting point shows that the strength of the latera adhesion between the large hydrocarbon molecules i at least as important as the strength of attachmen to the surface.

As we have seen, at the loads used in our experi ments, fatty acids in themselves are scarcely mor effective as boundary lubricants when applied to unreactive surfaces than saturated hydrocarbons. Even when they form well-adsorbed and orientated films on platinum or nickel surfaces, they do not lubricate above their bulk melting points. This means that even the longest-chain fatty acids do not lubricate unreactive surfaces at temperatures above about 90° C. The softening points of metallic soaps, however, are usually very much higher than the melting points of the pure acids. For this reason fatty acids are much more effective as boundary lubricants at heavy loads and high temperatures if they are used in the form of metallic soaps. This may be achieved by applying them to metal surfaces with which they react. The metal soap is then formed *in situ* and is well attached to the surface. In many cases even a monolayer of such a film is sufficient to prevent much penetration and metallic contact; in other cases, however, appreciably thicker films may be necessary. These films maintain their lubricating properties with increasing temperature until the softening point of the soap is reached. At this stage the film softens or melts, and increased metallic contact occurs through it, with corresponding increase in friction and wear. As the soap film loses its lateral adhesion, its linkage to the metal surface also grows weaker, and the breakdown of the lubricant film is often accompanied by its dissolution into the superincumbent oil or excess acid.

If the metal surface is unreactive, the fatty acid will not lubricate above its bulk melting point, and st be applied as a metallic soap. In such cases e physical texture and the mode of deposition of ese films may be very important. The best fric- nal properties are obtained when the soap film has lose coherent texture, is evenly deposited over the rface and is well adsorbed. These films will lubricate til the softening point of the soap occurs. If, how- er, the adsorption of the soap to the surface is ak and there is a superincumbent layer of oil esent, it may dissolve in the excess oil at a tem- rature lower than its softening point. If there are lvents present in appreciable quantities in the soap m, violent ebullition may cause them to disrupt e lubricant film. In both cases breakdown of the bricant film will tend to occur at temperatures low the softening point of the metallic soap.

The softening point of a soap is not clearly defined and ay cover a wide temperature range. The actual tem- erature at which the weakening of the soap film is fficient to cause an appreciable increase in metallic izure (and hence in the friction and wear) will early depend on the physical conditions of the xperiment. With hard surfaces, where the pressures e high, or with extremely slow surface speeds, we ould expect the breakdown to be discernible at wer temperatures. This is generally found to be e case—with any given metal and lubricant the ansition temperature T is dependent in this way pon the load, speed and shape of the sliding surfaces. t higher sliding speeds the formation of a viscous oap film of appreciable thickness may lead to a ydrodynamic separation of the surfaces. The condi- ions are no longer those of true boundary lubrication nd the friction may fall to a very low value (see the nteresting paper by Beeck, Givens and Smith[16] on quasi-hydrodynamic lubrication). The frictional behaviour of these soap films resembles in many respects the lubricating properties of thin films of soft metals deposited on hard substrates. This similarity has already been discussed in earlier papers. One of the most marked differences, however, is that even on rough surfaces a single molecular layer of soap may provide effective boundary lubrication, whereas metal films must be appreciably thicker (c. 10^{-6} cm.). The very high tenacity of the soap monolayer and its ability to prevent metallic seizure is, indeed, remarkable.

This view of the role of the lubricating film has been supported by recent work on the action of extreme-pressure lubricants and has led to the development of lubricants which maintain their boundary lubricating properties at very high temperatures.

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BIOCHEMICAL ASPECTS OF MENTAL DISORDER

SOME aspects of the biochemistry of mental disorder were discussed at a meeting of the Psychiatry Section of the Royal Society of Medicine on May 24.

Recent biochemical investigations into mental disorder were surveyed by Dr. G. D. Greville, who opened the proceedings. He dealt in the first place with the excretion of hippuric acid by schizophrenic patients after sodium benzoate administration. Quastel and Wales found, in a routine examination of schizophrenic patients, that a group of eighteen catatonic patients showed without exception impaired rates of hippuric acid excretion. In a group of twenty-seven non-catatonic schizophrenics, all but four gave hippuric acid excretions of the normal value and normal range of variation. Since none of the cases chosen for examination showed signs of renal or hepatic impairment, Quastel and Wales suggested that a metabolic disturbance in the liver might be a characteristic feature of catatonic patients. Strom-Olsen, Greville and Lennon repeated this work with sixty-two schizophrenic patients of whom twenty-eight were considered to be catatonic. They found that only five of the catatonic patients gave abnormally low values of hippuric acid excretion, the proportion being about the same as among non-catatonic schizophrenic patients. Such a finding seemed not to indicate any noteworthy difference between catatonic and other schizophrenic patients so far as benzoate detoxication is concerned. There was agreement, however, that a small but not insignificant proportion (18 per cent) of non-catatonic schizophrenic patients without obvious renal or hepatic disturbance give abnormally low rates of excretion of hippuric acid under the standard test conditions.

Quastel and Wales then repeated their work using an intravenous method of benzoate administration to avoid a possible complication due to faulty absorption of benzoate from the gut and confirmed their original findings. Moreover, they obtained evidence that the clinical condition of the patient at the time of the test may have an important bearing on the rate of benzoic acid detoxication, for certain patients who had previously shown low rates of hippuric acid excretion exhibited normal rates after improvements in their mental condition due to treatment. Subsequent workers (Davies and Hughes; Finkelman *et al.*) have confirmed that abnormally low rates of hippuric acid excretion may occur in a large proportion of catatonic cases, but others (Gildea; Michael, Looney and Borkhovic) could obtain no evidence for such low excretions. Dr. Greville showed that the discrepancy between the results of the various workers could not be due to a failure to take into account the body-weight of the patients. Muscular rigidity may be a factor associated with the lowered rate of excretion according to Finkelman, but no satisfactory explanation is as yet forthcoming to account for the different sets of results.

Dr. Greville then turned to a consideration of the spontaneous hypoglycæmia which sometimes develops in the psychoneuroses and other abnormal mental conditions, and commented upon the development of emotional disturbances, often leading to behaviour of an anti-social character, during the periods of hypoglycæmia. Hypoglycæmia frequently occurs in children whose ill-behaviour in this condition can often be improved by giving them sweets. He dealt with some of the work on carbohydrate metabolism which has been carried out on psychotic patients by means of glucose tolerance tests, measurements being made in these tests of the rates of appearance and subsequent disappearance of blood-sugar after oral ingestion of glucose. McCowan and Quastel showed that among manic-depressive patients, those exhibiting a high emotional tension gave a high hyperglycæmic index, a term coined by these workers to give a quantitative expression to the divergence between an abnormal and a normal oral-glucose tolerance curve. The patients on recovery showed a low or zero index, the value found in normal mental conditions where there is no complication due to physical factors affecting glucose metabolism in the body.

Gildea and his colleagues, as a result of their work on oral and intravenous-glucose tolerance curves in manic depressive patients, concluded that abnormal oral-glucose tolerance curves leading to a high hyperglycæmic index are largely due to delayed absorption of glucose from the gut. This conclusion is supported by the observation by Davis and Greville that in depressed patients there exists a correlation between the slope of the initial portion of the glucose tolerance curve and the hyperglycæmic index. The lower the initial rate of rise of blood-sugar, the more sustained is the hyperglycæmia. It seems probable that with a constant carbohydrate intake the factor which largely determines the initial stage of a sugar tolerance curve is the rate of absorption of the sugar from the alimentary tract. It thus appears evident that there is a correlation between this rate and the emotional state of the patient.

Dr. Greville finally mentioned recent work (for example, that of Gibbs) on the oxygen consumption of the brain as measured by differences between arterial and venous contents of oxygen, and by the rate of blood flow to the brain. It seems to be clear from the work of Wortis that there is no measurable difference between the rates of oxygen consumption of the brains of normal and schizophrenic individuals. Himwich and Fazekas conclude that cerebral oxygen uptake is normal in a group of undifferentiated mental defectives, but that it is probably reduced in mongolism, cretinism, phenylketonuria, and microcephaly. Little is known as yet of the changes occurring in the brain during the shock therapies commonly used in the treatment of schizophrenia, but there is evidence that marked changes of metabolism do take place. This is clear, for example, in insulin shock treatment, where a large reduction in the arterio-venous difference of oxygen content takes place, while the rate of blood flow is unaffected. It is unreasonable to expect that the cerebral metabolic changes will be identical in all forms of shock therapy, which differ so much in intensity and duration and which are by no means all equally effective.

The biochemical aspects of anxiety were discussed by Dr. D. Richter. He pointed out that the blood of patients with anxiety contains a substance which is absent from normal blood and which exerts a specific action on plain muscle. It has also been shown by Gellhorn and his colleagues that in emotional excitement there is a release of insulin into the blood. This is an effect which can be measured quantitatively, and should help in elucidating the details of the close association betwe anxiety states and the endocrine balance.

An emotional hyperglycæmia has been frequent reported, but many investigators have failed confirm this. Dr. Richter has carried out blood-sug estimations on patients with anxiety states and normal subjects during air raids at the Neuros Centre at Mill Hill. About one third of the subjec showed a slight rise in blood-sugar level when expose to immediate danger, but the rise was never ve great. He referred to further work at Mill Hill whic showed that serum choline esterase activity increased in anxiety states and in depression. rise can also be produced in normal subjects b vigorous exercise or by exposure to low temperature The effect is attributed to an increased autonom activity and is apparently specific for cholin esterase.

Dr. Richter observed that during the last fe years there has been a tendency to depart from th point of view concerning anxiety states held b Cannon and his associates. In acute emotional state there is a general lability of autonomic control which many apparently unrelated biochemical factor may be involved. The pattern of responses, instea of being uniform, shows considerable variations i different individuals, and there is little evidence tha they serve any useful biological purpose. A variet of biochemical factors may play a part in the onse of anxiety states, as for example, hypoglycæmia aneurin deficiency or adrenaline release. Anxiet may be a symptom of almost any physical disability to which the individual is unable to adjust. Recent work on patients with 'effort syndrome' has shown how a biochemical lesion causing an impairment of physical efficiency can lead to the onset of an anxiety neurosis.

The discussion was opened by Dr. J. H. Quastel, who commented upon the diversity of results obtained by different workers on the rates of hippuric acid excretion in catatonic patients submitted to a standard test. He emphasized the dependence of these rates on the clinical conditions of the patients, and urged the great importance of close association and co-operation between the psychiatrist and the biochemist in correlating the results of a biochemical test with the patient's mental and physical condition at the time of the test. The lack of agreement between the results of metabolic investigations in the field of schizophrenia may be largely due to the fact that such a field is far from homogeneous and the individual schizophrenic patient shows much variation in mental state and physical condition over a period of time. For progress in such work it is essential to select a small field where there is some approach to homogeneity and to examine cases in such a field periodically. The interesting results of Gjessing on the metabolic changes associated with changes in the mental state are probably due largely to his selection and continuous examination of a small number of schizophrenics conforming to a special group of periodic catatonia which is characterized by repeated attacks of stupor and excitement. Gjessing concludes that the mental disturbance follows directly upon a disturbance of nitrogen metabolism, and suggests that at the time of change of phase a toxic substance is produced which is connected with the disturbance of protein metabolism and which acts in an inhibitive or irritant manner on the central nervous system.

Although there is no convincing evidence, in Dr.

stel's opinion, that impaired oxidations in the in play an important part in schizophrenia, the itivity of the cortex to anoxia is such that lized changes may result in abnormal mental ifestations with but little overall change in the n metabolism. It is important to take into conration not only the availability of oxygen or of ose (the main fuel of the brain) to the nerve cell also that of a variety of other factors, all indissable for the normal rate of oxidation of glucose the cell. Among such factors are nicotinamide, urin, riboflavin and adenylpyrophosphate. If re is a local deficiency of these substances, or some erference with their activities, the results, so far the nerve cell is concerned, may be as far-reaching their consequences as the deprivation of the oxygen of the glucose supply. The sensitivity of the cortical ue to anoxia may be a factor concerned with the eficial effects of shock therapy, but too little is own as yet of the effects of these treatments on metabolism of the central nervous system to come any definite conclusion.

Referring to the work on glucose tolerance tests d emotional states, it was pointed out that Lockwood s observed a dependence of the hyperglycæmic lex on the affective state as indicated by the ychogalvanometer.

Interesting results are now being obtained with e use of the electro-encephalogram on the conxion between biochemical activities of the brain d its electro-physiological properties. Studies such these should help to throw light on the manner in hich biochemical and electrophysiological phenmena connected with the central nervous system are nked with the mental state.

Dr. R. Benesch referred to work carried out by im in collaboration with Dr. P. Ellinger on certain icotinamide-deficiency syndromes, namely, pellagra nd the acute psychoses of the Cleckley-Sydenstricker ype. Ingestion of nicotinamide normally leads to he excretion of nicotinamide methochloride. Benesch nd Ellinger have shown that large differences in the asal output of nicotinamide methochloride, and in he output after nicotinamide administration, exist etween control subjects and pellagrins as well as acute psychoses with a suspected nicotinamide eficiency. The mental confusion present in such ases clears up after nicotinamide treatment. They urther showed that human intestinal flora are capable of synthesizing nicotinamide, so that a diet may inhibit the development of pellagra quite independently of its content of nicotinic acid. Thus the nature of a diet and the type of bacterial flora it encourages in the human intestinal tract are important factors to consider in the development or treatment of nicotinamide-deficiency disorders.

In general discussion it was pointed out that choline esterase is exceptional in presenting an example of an enzyme passing into the blood concomitantly with the development of an anxiety state or of an increased autonomic activity. Its appearance in the blood, however, will not, according to Dr. Richter, invalidate its use as a test for liver function. Further discussion ranged around the association of incipient pellagra with porphinuria and the fact that sulphonal poisoning may produce pellagra-like symptoms.

It was suggested by Dr. Mackenzie that a patient might most profitably be presented for biochemical investigation at a time corresponding to a definite phase of his behaviour, rather than on the basis of his psychiatric classification.

OBITUARIES

Sir Peter Chalmers Mitchell, F.R.S.

PETER CHALMERS MITCHELL was born at Dunfermline on November 23, 1864, and died in London, as the result of an accident, on July 2, 1945. He was the eldest son of the Rev. Alexander Mitchell, and was educated at Aberdeen Grammar School, the University of Aberdeen, and at Christ Church, Oxford, where he was an exhibitioner. He also studied in Berlin and Leipzig. He became senior University demonstrator in comparative anatomy and assistant to the Linacre professor at Oxford in 1888, and during 1891–93 was organizing secretary for technical instruction to the Oxfordshire County Council. Afterwards he went to London as lecturer in biology at Charing Cross Hospital and at the London Hospital. During this period he carried out various comparative studies mainly on the anatomy of birds, and in the course of this work spent much time at the prosectorium of the Zoological Society. About this time he published his "Outlines of Biology" and "Thomas Henry Huxley: A Sketch of his Life and Work", an outstanding biography which perhaps more than any other of his writings reveals his literary gifts. He also translated Metchnikoff's "The Prolongation of Life, Optimistic Studies" and O. Hertwig's "The Biological Problem of To-day. Preformation or Epigenesis ?".

Mitchell will be remembered mainly, however, for his very great services as secretary of the Zoological Society of London from 1903 until 1935. During this period, by a judicious blending of popular and scientific interests, it became the leading zoological society in the world, a great popular and scientific institution, and a model for the many similar societies which sprung up during the twentieth century. Some idea of its progress may be gathered by the fact that between 1903 and 1935 the number of fellows increased from approximately 3,500 to more than 8,000, and the annual number of visitors to the Gardens from approximately 690,000 to more than 2,000,000. During his term of office the Zoo was largely rebuilt, the most notable additions being the Mappin Terraces, Aquarium, Reptile House, Monkey House and Monkey Hill. In addition, he was entirely responsible for the creation of Whipsnade Zoological Park, a monument to his energy, imagination and organizing ability. He himself regarded Whipsnade as his crowning achievement on behalf of the Zoological Society, and there he made his country home after leaving Malaga. His "Centenary History of the Zoological Society of London", published in 1929, contains an excellent account of the growth of the Society and the development of its various activities, including both Regent's Park and Whipsnade.

Apart from his zoological interests, Mitchell devoted much of his time to journalism and for many years was scientific correspondent of *The Times*, a regular leader writer, and that journal's adviser upon scientific matters. He was also chairman of the council of management of the "World List of Scientific Periodicals" from its beginning until 1935, and remained an active member of that organization until his death. He was largely responsible for the preparation of the volume which, in its second edition (1934), gives the titles and standard abbreviations of more than 36,000 periodicals.

After his retirement, Mitchell went to live at Malaga, but in 1937 political events debarred him from remaining there and he returned to London, when he published "My Fill of Days", a record of his long and interesting life, and in the next year "My House in Malaga". For the last three years he had been honorary treasurer of the Joint Committee for Soviet Aid, which raised considerable sums of money for providing supplies for the U.S.S.R.

Mitchell had a most attractive personality, and with his keen though somewhat sardonic humour was a very persuasive talker. He had a great natural fondness for animals and was for many years president of the Universities Federation for Animal Welfare. He took an active interest in the protection of wild life generally, and was an active member of the Society for the Preservation of the Fauna of the Empire, being president during 1923–26 and afterwards a vice-president until his death.

He was elected to the Royal Society in 1906; in addition, he received numerous academic and public awards, and was knighted in 1929.

EDWARD HINDLE.

Brigadier-General Sir Percy Sykes

BRIGADIER-GENERAL SIR PERCY SYKES, who died on June 11, was an authority on Persia on account of the many years he lived there, his historical writings, and his numerous journeys through it. He also made exacting expeditions in Central Asia. He travelled with a historian's bias which served to people desolate roads and to link dreary adobe ruins or scattered shards of pottery with happier and perhaps splendid days in the past. During much of his travelling life he had the advantage of official status and prestige, but this was less important than the courage and audaciousness with which he flouted the dangers of travels fifty years ago, and the tough body and sturdy health which enabled him to endure hardships of the road and stays in infected Persian towns. No tales of insecurity would deflect him from his purpose, nor would the very real risk of a clash with slave raiders deter him from following a route chosen because it was little known or infrequently used.

Sir Percy's most important journeys were in Eastern Persia, north, central and south. Fifty-two years ago he followed the River Atrek from the shores of the Caspian into the gorges near Bujnurd. This meant crossing the marches between the unruly Turkomans and the Kurdish settlers put there to hold them at bay, and this he did adventurously alone. Many years later he filled in details along this little-known valley, from the prosperous populous headwaters near Kuchan to the uninhabited wastes near the Russian border. On his first journey he also crossed the Lut from Meshed to Kerman. During the next twenty years he filled posts at both these cities, and as he never liked to follow the same road twice he was able to amplify the traverses he made in a regional way.

Farther south Sir Percy crossed Persian Baluchistan on intersecting trails and climbed Taftan, Bazman and Hamant, all of them high enough to provide comprehensive views over hundreds of square miles of unexplored territory. Two of these mountains are young volcanoes standing more than two hundred miles from the sea, and their discovery did something to discourage the fallacy that volcanoes are only to be found close to the sea and to depend upon the breaking in of sea water to the depths of the earth's crust for their activity. He was responsible for m new facts regarding the Jaz Murian basin, an probably the only European who has penetrated valley of Ramishk. He had an opportunity of visi the wind-stricken Seistan depression, where Afghan Helmand discharges, and on the way ad to the knowledge of the eastern rim of Persia w extends four hundred miles south of Meshed Birjand. As commander of the South Persian R during the War of 1917–18, he had further op tunities for travel and the services of surveyors extended his mapping.

Apart from the geographical aspect of his w Sir Percy made noteworthy archæological discove in Eastern Persia and studied the manners customs of the people.

J. V. HARRISO

SIR PERCY SYKES was a true embodiment of tradition which makes a British officer posted in East take interest in every aspect of Nature and around him. His geographical exploration m exceeded the utilitarian purposes of his official dut His earliest and most original work, "Ten Thous Miles in Persia, or Eight Years in Persia" (19 was very favourably received both in Great Brit and abroad. It contains a great mass of fr observations on the antiquities, history and ethnolo of eastern Persia. The work was continued in a ser of reports on the journeys in Khorasan, etc., writ in the same vein and published in the *Geographi Journal*. Small notices on the Gypsies, the Pa and prehistoric remains, which he contributed to su organs as the *Journal of the Royal Anthropologi Institute, Journal of the Royal Society of Arts*, et were also interesting, and often started further use discussion among the specialists.

Sir Percy was no professional Orientalist bu working with the help of his *munshis*, he easily fou in the original sources references to illustrate h descriptions. This is particularly noticeable in h notes on the famous mosques of Meshed. Man curious details on the pilgrimage to this sanctuar are recorded in the memoir prepared by one of h Muslim assistants and published in his translatio under the title "The Glory of the Shia World" (1910

Sir Percy's main interest lay in Persia, and h second book of travel, "Through Deserts and Oase of Central Asia" (1910), written in collaboration wit his sister, the late Miss Ella Sykes, had a much mor popular form. It summed up the impressions of hi journey through Russia in 1915, of his temporar term of office as Consul General in Kashghar and o his hunting expeditions in the Pamir.

More ambitious were his historical works. Hi two volume "History of Persia" went through thre editions (1915, 1921 and 1930) and has been recentl translated into Persian. For the earlier periods Si Percy naturally depended on the contributions o his collaborators, but from A.D. 1600 on the book contains many interesting items on the relation of Persia with Europe and particularly with Grea Britain. In the additions to the third impression, the author recorded his personal experiences in Fars during the disturbances which followed the first European War.

The biography of Sir Percy's former chief, the Right Hon. Sir Mortimer Durand (published in 1926), formed a transition to a new field of his studies: in 1940 appeared his two-volume "History of Afghanistan". The book is a useful summary of the great mass of information found in English publications, and partly in official archives.

In the interval between the two "Afghanistan" books appeared "A History of Exploration from the Earliest Times to the Present Day" (1934). The volume covers a vast field and is particularly helpful in the chapters on Central Asia, the area on which the author ever kept a watchful eye. As a supplement to it came "The Quest for Cathay" (1936), popularizing the data of the Hakluyt series.

If to this enumeration of the principal works we add a number of occasional articles in the *Royal Central Asian Journal*, etc., and prefaces to the joint-effort books and translations, we shall recognize how well Sir Percy employed the leisure hours of his busy official life and the years of his retirement. His contribution to the knowledge of the Middle East and its manifold problems has been considerable and conspicuous.

V. Minorsky.

Prof. L. I. Mandelstam

Prof. L. I. Mandelstam, an outstanding Russian physicist and member of the Academy of Sciences of the U.S.S.R., died in Moscow on November 27, 1944, when at the height of his powers. Mandelstam was endowed with an unusually profound and subtle mind. He was at once a brilliant experimenter, an outstanding theoretical worker, a profound thinker, especially interested in the problems of epistemology and of the philosophy of science, and an outstanding expert in radio-engineering.

Mandelstam was born in 1879 in the south of Russia. He was educated at the University of Strassburg, where he began his scientific career as Prof. F. Braun's assistant; he became a *Privatdozent* in 1907 and obtained the title of professor in 1913. Together with N. D. Papalexi, his life-long collaborator, he carried out in that period a number of physical and technical researches of importance to the new subject of radio-engineering. He was the first to demonstrate the advantages of weak coupling (1904), which has since received wide practical application; he developed the method of the excitation of aerials with a prescribed phase difference (1906), and originated other technical advances.

Mandelstam's characteristic ability to discover deep inner ties between apparently unconnected phenomena soon directed his attention to another branch of physics, namely, optics, and particularly to the problem of the scattering of light, which throughout his life remained of prime interest to him. Mandelstam was the first to demonstrate, in 1907, that the lack of optical homogeneity of the medium is the necessary condition for the molecular scattering of light which is due to radiation of atomic oscillators vibrating with definite phase relationships. This fundamental conclusion cleared the way for establishing the fluctuating nature of scatter; Mandelstam himself followed up this work with a statistical theory of scattering of light on the surface of a liquid (1913). A number of other beautiful researches in optics were carried out during this period.

In 1914, Mandelstam returned to Russia, and his most creative period was the last twenty years of his life, after his election to a professorship in the University of Moscow in 1925 and to the membership of the Academy of Sciences in 1929. Mandelstam's lectures at Moscow were unsurpassed examples of university teaching, in which the borderline between teaching and creative scientific research vanished; not infrequently, during these lectures, problems originated that became later the subjects of scientific investigations.

Mandelstam's researches in the physics of oscillations were now given a new impetus. A master of the classical theory of oscillations, Mandelstam was clearly aware of its limitations and realized the necessity for developing a new 'non-linear' system of ideas and methods, that would be adequate to the new problems suggested particularly by the development of radio-engineering. He and his pupils searched persistently for these new methods, developing a theory of non-linear oscillations which gave fundamental results in the most varied branches of physics: radio, hydrodynamics, aerodynamics, the theory of automatic regulation and others. Mandelstam himself carried out a number of these important researches in collaboration with Papalexi, as for example the discovery of the phenomenon of resonance of the *n*-th kind, the so-called parametric filter based on this phenomenon, an important generalization of the conception of resonance, and the development of a new type of a generator of alternating current (the so-called parametrical machine).

Proceeding from optical analogies, Mandelstam and Papalexi invented radio interference devices, in particular the radio range-finder, by means of which precision measurements of the velocity of propagation of radio waves in varied conditions were carried out, and a new sphere of radio application developed, namely, radio-geodesy, which is now made use of in the Soviet Arctic regions as well as other parts of the U.S.S.R.

During the same period, Mandelstam and his collaborators carried out important optical investigations. Introducing into optics the conception of the modulation of oscillations, Mandelstam in 1918 came to the conclusion that the scattering of light must be accompanied by a change of frequency, conditioning the fine structure of scattered light. Experimental search for this phenomena led Mandelstam and Landsberg to the fundamental discovery of combinational scattering of light in crystals. Their first publication was dated May 6, 1928, and soon it became clear that the phenomenon discovered by them was of the same nature as the combinational scattering of light in fluids, simultaneously discovered by Raman, announced on March 31 of the same year, and since known as the Raman effect.

In the course of many further researches on the scattering of light, Mandelstam's attention was attracted to the absorption of ultra-acoustic waves. A relaxation theory of this phenomenon, developed by him in 1936, gave rise to a series of experimental researches in this direction.

Of late, Mandelstam's scientific interests turned primarily to the fundamental problems of quantum mechanics. He was the first to deduce the uncertainty relation between time and energy from the general formalism of quantum mechanics, and to reveal the simple physical meaning of this fundamental relation. In a course of his lectures on the theory of measurements of quantum systems, Mandelstam gave an interpretation of the theory unsurpassed in its clarity and depth; in particular, he pointed out the fundamental distinction between direct and indirect measurements of quantum systems, which is of great importance to the further development of quantum theory.

Mandelstam's published works do not do justice to his many-sided scientific interests. He was generous in imparting his ideas to friends and collaborators, so that much which was really his appeared under another's name. Also, because of the very high standards that he demanded of himself, Mandelstam delayed, especially of late, the publication of his researches. For this reason much of his work will not be generally known until the posthumous edition of his collected works, which the Soviet Government has decreed, is published. His scientific researches earned him the Lenin prize, the Mendeléeff prize and the Stalin prize. For his general scientific and teaching work he was awarded the Order of the Red Banner and the Order of Lenin.

Mandelstam was a man of infinite kindness, possessed of great spiritual and intellectual charm that never failed to impress anyone who came into contact with him. Those who had the good fortune to know him more intimately will always cherish the memory of this scientific worker and man.

P. KAPITZA.
A. JOFFÉ.
S. VAVILOV.

WE regret to announce the following deaths:

Mr. R. W. F. Harrison, sometime assistant secretary to the Royal Society, on July 15, aged eighty-seven.

Dr. J. C. Kernot, an authority on adhesives, on July 6, aged sixty-six.

Lieut.-Colonel J. C. Lamont, C.I.E., sometime professor of anatomy at Lahore Medical College, on June 19, aged eighty.

Prof. W. Makower, O.B.E., formerly professor of science at the Royal Military Academy, Woolwich, on July 7, aged sixty-five.

Dr. Catherine A. Raisin, formerly head of the Department of Geology, Bedford College for Women, University of London, on July 13, aged ninety.

Colonel C. H. D. Ryder, C.B., C.I.E., formerly surveyor-general of India, on July 16, aged seventy-seven.

Dr. Alec Sand, F.R.S., physiologist to the Marine Biological Association since 1935, early in July, aged forty-three.

Mr. F. H. Todd, formerly of the Indian Forest Service, on July 9, aged seventy-one.

NEWS and VIEWS

Prof. George Hevesy, For.Mem.R.S.

PROF. GEORGE HEVESY celebrates his sixtieth birthday on August 1 in Sweden, where he is a guest of the Royal Swedish Academy of Science in Stockholm. Members of the Academy have prepared a jubilee volume to mark the occasion. Prof. Hevesy and his family escaped from Denmark to Sweden when racial persecutions in Denmark and the tide of terrorism by the German occupants reached a climax in 1944. Prof. Hevesy is well known especially for his work on isotopes, including the early use of radioactive tracer atoms in investigations on diffusion in crystals and later on numerous biochemical problems, involving among others the study of the metabolism of phosphorus in organisms. His other great field of contributions to modern science is the discovery of the element hafnium, the chemical separation of hafnium from zirconium and the study of the properties of hafnium compounds. The relationship between hafnium and zirconium led him to the problem of the rare earth elements. Later, he developed quantitative analysis by means of his X-ray technique for the study of the geochemical frequency and distribution of numerous elements.

Prof. Hevesy, a Hungarian by birth, has held professorial chairs in Denmark (Copenhagen), in Germany (Freiburg-i.-B.) and from 1934 again in Denmark, where his work has been closely associated with the famous Institute of Theoretical Physics at Copenhagen directed by Niels Bohr. In just recognition of his contributions, he was awarded the Nobel Prize for Chemistry for 1943. He has many ties with scientific men in Britain. For a period beginning in 1911, he worked in the late Lord Rutherford's laboratory when the latter was at Manchester. He frequently visited Britain to attend scientific meetings; and in 1930 he gave the Hugo Müller Lecture before the Chemical Society. A number of British research students worked at his laboratories. Hevesy's many friends in Great Britain and elsewhere will be glad to know that he and his family are well, and will wish him many years of continued successful work and of happiness.

Chair of Geography at Sheffield: Prof. R. N. Rudmose Brown

THE retirement of Prof. R. N. Rudmose Brown from the chair of geography at the University of Sheffield at the end of this session marks the official end of nearly forty years of teaching and guiding university geography. His influence on the subject outside his university has been exercised through his being a member at one time or another of all the more important councils and committees which have to deal with geography, as well as through his books. Though he approached the subject from the point of view of a polar explorer and a naturalist, he has always insisted upon the essential unity of its physical and human aspects. His many contacts with French and other Continental geographers may have been the spur which caused him to become as notable a lecturer and writer on the human and economic aspects of his subject as the biological and physical side. His contribution to the recent advance of academic geography has therefore been based on the broadest grounds. This is reflected in his new building for his Department at Sheffield, which is second to none in Great Britain. Planned by him to serve with equal emphasis all the aspects of modern geography, it is a model which will be copied elsewhere in due course. As counsellor, examiner, writer, editor and practical explorer, Prof. Rudmose Brown has had an influence on geography which will endure. His rugged honesty of purpose and direct speech will be missed in many a council chamber, but it is quite certain that his years of retirement will often be interrupted by requests for advice from his younger colleagues, who will continue to be attracted by his wisdom and breadth of vision as well as by his long experience and commanding personality.

Squadron-Leader David L. Linton

SQUADRON-LEADER DAVID L. LINTON, who succeeds Prof. Rudmose Brown at Sheffield, is thirty-eight years old, and was well known in British geographical science before the War. He had been an exceptionally distinguished student at King's College, London; and after a period on the staff of the Geography Department there, he became a lecturer in geography under Prof. A. G. Ogilvie at the University of Edinburgh. His published researches into the relations between land forms and river drainage brought him (jointly with his collaborator, Prof. S. W. Wooldridge) the Murchison Grant of the Royal Geographical Society; and besides other work on geomorphology he has published studies in historical, general and economic geography. His teaching experience is also wide. Before the War he was secretary to the Geography Section of the British Association, and on the Council of the Institute of British Geographers and that of the Royal Scottish Geographical Society. His service with the R.A.F.V.R., in which he won successive promotion to squadron-leader, has been in photographic intelligence, in which he is in charge of a H.Q. Department.

Fellowships for Scientific Research in India

I.C.I. (India) have offered to the National Institute of Sciences of India the sum of 336,000 rupees (about £25,000) for research fellowships in chemistry, physics and biology, to be held at Indian universities or institutions approved by the Council of the National Institute of Sciences, over a period of five to seven years. Each fellowship will be worth 400 rupees per month and will be tenable in the first instance for two years. There is provision for four new fellowships every year during the period 1945–49. In addition, there will be a grant for research expenses to be made to the fellowship holders according to their needs of special apparatus and materials. For this purpose the National Institute has at its disposal an average of 600 rupees per annum for each fellowship. There will be a grant of 13,200 rupees per annum to the National Institute for five years to enable it to pay for administration and the travelling expenses of such fellows of the Institute as may be selected to visit the fellowship holders at their universities or institutions. Appointment to, and control of, the fellowships will be in the hands of the Council of the National Institute, acting on the advice of a special research fellowships committee, representative of various scientific fields and drawn from various parts of India, so as to include any community, the overriding consideration for membership being scientific fitness therefor. The fellowships will be open to persons, irrespective of sex, race or religion, resident or domiciled in India (British India or the States) and less than thirty-five years of age, and will be tenable at any university or institution in India approved by the Council of the National Institute. Fellows will be permitted to do a limited amount of approved teaching or demonstrating.

The aim of the fellowships is to strengthen research in Indian universities and institutions, and it is hoped that the National Institute of Sciences will spread the research fellowships over them in accordance with this aim, but with the overriding consideration of the scientific suitability of the particular university or institution. As Lord McGowan points out in his letter conveying the offer to the president of the National Institute, these fellowships should do something to encourage the advance of science in India and with it the general prosperity of the country; further, they should assist the National Institute in maintaining its position as the premier scientific body of India. The offer is in many ways parallel with that made to British universities a short time ago by Imperial Chemical Industries, Ltd., and, it may be presumed, is inspired by the suggestions made by Prof. A. V. Hill in his recent report on research in India (see *Nature*, May 5, p. 532).

Education in H.M. Forces

An encouraging feature in the latest report of the Central Advisory Council for Education in H.M. Forces (October 1944–March 1945) is the considerable increase in the number of organized classes as opposed to single lectures conducted in Service units (see *Nature*, 155, 611; 1945). The latter have decreased by some 19 per cent, while the former show the significant rise of 37 per cent. Outside units, the number of intensive schools and conferences also shows a remarkable increase, and it is particularly gratifying that a growing proportion of these schools and conferences are being conducted on a residential basis. It is distressing, therefore, to find that while there is every indication that the demand for intensive courses will increase, there is little likelihood of the demand being met in full unless residential accommodation is made much more freely available. Four university institutions have already lent hostels for whole-time use for regional committee courses, but more help is urgently needed from Service authorities towards the initial cost of reconditioning buildings and also in facilitating the release of suitable premises.

Although the number of occasional lectures in science shows the same downward trend as single lectures in other subjects, the rapid increase in the number of science classes in units is a useful indication of the way in which Service men and women are pursuing their studies with more serious intent; it is noteworthy that there has been a big shift from 'non-vocational' to 'vocational' science. Several background courses in science, lasting a week or a fortnight, have also been held, usually at university centres. One regional committee broke new ground by instituting experimental courses on British industries. The object was to provide unit instructors with background information about the actual structure of some of Britain's major industries and then to discuss some of the problems that the industries would have to face in the future. Lectures were given by specialists on various aspects of the industries considered, while visual and other mechanical aids were used to supplement the teaching and discussion. Visits to works and firms also served to provide the necessary balance between detailed knowledge and general understanding of the broad issues affecting each industry. Other useful work carried out by the Central Advisory Council during the half-year covered by the report was that for soldiers and auxiliaries in hospitals and convalescent homes.

Argentine–British Medical Centre, Buenos Aires

An Argentine–British Medical Centre has been established in Buenos Aires, with the assistance of the British Council, to promote closer relations and to facilitate the exchange of information between the British and Argentine medical professions. The Centre has a Committee of Honour, the twenty-two Argentinian members of which include Prof. José Arce, Prof. Pedro Escudero, Prof. B. A. Houssay and Prof. Alfredo Sordelli. British representatives of various branches of medicine have been invited to join this Committee. On the Executive Committee are the president of the Centre (Prof. Dr. Mariano R.

Castex), the director (Prof. Dr. Antonio Eqües), the secretary (Dr. R. Castro O'Connor), an assistant secretary, three ordinary members, and two representatives of the British Hospital in Buenos Aires. The Centre's library contains a selection of the most important British medical journals and up-to-date text-books. When an inquiry cannot be answered on the spot, the Centre obtains, through the British Council, information, articles and books (or photostat copies) from Britain. Among the activities are distribution of the "British Medical Bulletin" (Spanish edition), supply of medical films, translations from English into Spanish and Spanish into English, and certain facilities for members wishing to subscribe to British medical journals, or buy British medical books. The facilities are available to medical men in the interior of Argentina, who, since they are not in a position to borrow original books and articles, are supplied with photostat copies.

University of London Appointments

The following appointments have been made in the University of London: Dr. D. H. Hey, since 1941 director of research at the British Schering Research Institute, to the University chair of chemistry tenable at the Imperial College of Science and Technology; Dr. F. C. Benham, to the University chair of commerce tenable at the London School of Economics; since 1931 he has been Sir Ernest Cassel reader in commerce at the School. Mr. D. W. Harding, special lecturer in psychology in the University of Manchester, to the University chair of psychology tenable at Bedford College.

Mr. Raymond Irwin, county librarian of Lancashire, has been appointed to the directorship of the School of Librarianship at University College as from October 1.

The title of reader in bacteriology in the University has been conferred on Mr. J. C. Cruickshank, in respect of the post now held by him at the London School of Hygiene and Tropical Medicine.

The degree of D.Sc. as an internal student has been conferred on the following: Mr. C. R. Bailey (University College); Mr. R. V. Harris (Imperial College of Science and Technology); Mr. G. W. Padwick (Imperial College of Science and Technology); Mr. L. Young (University College and Imperial College of Science and Technology).

The Night Sky in August

New moon occurs on August 8d. 00h. 32m. U.T., and full moon on August 23h. 12h. 03m. The following conjunctions with the moon take place: August 2d. 23h., Mars 2° N.; August 4d. 16h., Venus 1° S.; August 5d. 23h., Saturn 1° S.; August 9d. 07h., Mercury 9° N.; August 11d. 06h., Jupiter 4° S.; August 31d. 13h., Mars 0·9° N. In addition to the conjunctions with the moon, Venus is in conjunction with Saturn on August 22d. 04h., Venus being 0·7° S. Only one occultation of stars brighter than magnitude 6 takes place in August; ξ Tauri is occulted on August 4d. 3h. 28·9m. Mercury sets at 20h. 18m. at the beginning of the month—half an hour after sunset—and is not well placed for observation. The planet is stationary on August 5 and 29 and is in inferior conjunction on August 20. Venus is conspicuous in the eastern sky, rising at 1h. 11m., 1h. 22m. and 1h. 50m. at the beginning, middle and end of the month respectively. Mars, in the constellation of Taurus, rises at 23h. 47m., 23h. 20m., and 22h. 54m., at the beginning, middle and end of the month respectively. Jupiter sets about 1½ hours after the sun at the beginning of August and less than three-quarters of an hour after the sun at the end of the month, and is not well placed for observation. Saturn can be seen in the early morning hours, rising at 2h. 37m. and 0h. 56m. at the beginning and end of the month. The Perseid meteors reach their maximum about August 10–12; the radiant is at R.A. 3h., dec. 45° N., close to κ Persei.

Announcements

Prof. H. M. Turnbull, director of the Pathological Institute of the London Hospital and professor of morbid anatomy in the University of London, has been given the honorary degree of D.Sc. of the University of Oxford.

Prof. A. C. Hardy, regius professor of natural history in the University of Aberdeen and honorary director of oceanographical investigations in the University College of Hull, has been appointed Linacre professor of zoology and comparative anatomy in the University of Oxford, in succession to Prof. E. S. Goodrich.

Dr. Irene Manton, lecturer in botany in the University of Manchester, has been appointed professor of botany in the University of Leeds, in succession to the late Prof. J. H. Priestley.

Mr. A. B. Hornblower, honorary general secretary of the London Natural History Society, has resigned the position he has held for the past sixteen years, owing to ill-health. Mr. H. A. Toombs of the Geological Department, British Museum (Natural History), Cromwell Road, S.W.7, has been appointed to take his place; particulars of the Society's activities can be obtained from him.

The Minister of Town and Country Planning, Mr. W. S. Morrison, has appointed the following National Parks Committee: Sir Arthur Hobhouse (*chairman*), Lieut.-Colonel E. N. Buxton, Mr. John Dower, Mr. Leonard K. Elmhirst, Mr. R. B. Graham, Dr. Julian Huxley, Mrs. Lindsey Huxley and Mr. Clough Williams-Ellis.

The following have been elected officers of the Institution of Electrical Engineers for the year beginning on September 30: *President:* Dr. P. Dunsheath; *Honorary Treasurer:* Mr. E. S. Byng; *New Members of Council:* Mr. L. H. A. Carr, Mr. J. G. Craven, Mr. J. Eccles, Mr. H. Faulkner, and Prof. Willis Jackson (members); Dr. J. M. Meek (associate member); Mr. A. F. Plummer (associate).

The report of the proceedings of the nineteenth conference of the Association of Special Libraries and Information Bureaux, December 9 and 10, 1944, has now been published by the Association, price 6*s*. The report includes the papers presented at the Conference together with summaries of the discussions, the presidential address of Sir Frederic Kenyon, a report of the year's work of the Association, 1943–44, reports on the work of the British Council and on the Inter-allied Book Centre evolved by the Conference of Allied Ministers of Education, with brief notes on the British Union Catalogue of Periodicals and on the National Central Library.

LETTERS TO THE EDITORS

he Editors do not hold themselves responsible or opinions expressed by their correspondents. No notice is taken of anonymous communications.

Regeneration of Mammalian Striated Muscle

SINCE the classic studies of Volkmann[1] there has en abundant experimental work which shows that. owing local injury, mammalian striated muscle is able of some degree of regeneration. But this enerative capacity is commonly held to be limited extent and abortive so far as functional repair is ncerned. It can now be stated that, under certain nditions, the regeneration of striated musculature y be much more extensive and complete.

Previous work which has been reported from this oratory[2] showed that if the main vessels supplying e tibialis anterior muscle of a rabbit are ligatured, e lower half or two thirds of the muscle can usually effectively devascularized and undergoes comete necrosis except for isolated fibres at the surface d alongside main anastomotic vessels, and some res at the lower end adjacent to the tendon. Moreer, it was found that within a few days the necrotic uscle becomes invaded by granulation tissue conining new muscle fibres of embryonic type which ream down from the ends of the surviving fibres the upper part of the muscle.

Further experiments have now been completed in rder to determine the fate of these regenerating bres. In two rabbits, the tibialis anterior muscle f both sides was effectively devascularized. Two ays later the muscles were exposed and bromohenol blue injected into the ear vein to determine he exact extent of the devascularization. In both ases the upper third of the muscle became stained n the normal manner, while approximately the lower wo thirds remained unstained, with a sharp line of emarcation between the two parts of the muscle. After three weeks the muscle was resected from one ide for histological examination. In each case the riginal muscular tissue in the lower two thirds was ound to have undergone practically complete dissoluion, and to be replaced in great part by strands of newly formed fibres extending down from above. The muscle of the other side was removed after three or four months. In one case it was somewhat shrunken and showed histologically patches of fibrosis and fatty infiltration in the lower two thirds, but there was also a considerable amount of mature muscular tissue. In the other case the muscle appeared quite normal to superficial inspection, and was found histologically to be composed of muscular tissue of approximately normal mature structure. It thus appears that in the rabbit the lower half or two thirds of the tibialis anterior can become completely reconstituted after undergoing ischæmic necrosis.

These experiments have provided abundant material for the study of the histogenesis of regenerating striated muscle, and this is now being undertaken. It may be said, however, that the material provides no support for the contention of Levander (recently expounded in *Nature* and elsewhere[3,4]) that in the course of the regeneration of mammalian muscle new muscle elements arise by the differentiation of generalized connective tissue cells; on the contrary, they appear to be formed entirely as outgrowths of pre-existing muscle fibres, thus confirming the conclusions of many other students of muscle regeneration.

Levander's conclusions seem to be based on an erroneous interpretation of the histological picture. In our material we have frequently seen the appearance of isolated 'myoblasts' arranged, as he describes, like a shoal of fish in the granulation tissue. But if these are examined by serial sections, the appearance is found in all cases to be due to the oblique sectioning of long continuous strands which can be ultimately traced without interruption to the stumps of pre-existing fibres. If there has been much distortion of the tissues (as has evidently occurred in Levander's material, in which necrosis was induced by the intramuscular injection of alcohol), the connexion between the young fibres and pre-existing fibres may not be easy to establish without the detailed study of large numbers of serial sections. Levander also supports his interpretation by the appearance of young muscle fibres in the neighbourhood of pieces of muscle transplanted into the subcutaneous tissue. He assumes that the original fibres of the transplant undergo complete necrosis. In fact, we have found that in such transplants some of the muscle fibres at the surface may survive and retain their vitality. Moreover, it should be noted that the outgrowth of new muscle fibres from old fibres proceeds with great rapidity. Their maximum rate of growth is at least 1 mm. a day.

Thus *individual* sections may show newly formed fibres at some distance from the position of pre-existing fibres, suggesting an independent origin. Our experiments do not, of course, exclude the possibility of such an origin, but this can only be established by experiments of a more critical character.

W. E. LE GROS CLARK.

Department of Anatomy,
University, Oxford.
June 11.

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[2] Clark, W. E. Le Gros, and Blomfield, L. B., *J. Anat.*, **79**, 15 (1945).
[3] Levander, G., *Arch. f. Klin. Chir.*, **202**, 677 (1941).
[4] Levander, G., *Nature*, **155**, 148 (1945).

Motor Response from Giant Fibres in the Earthworm

IT has recently been shown[1,2,3] by action potential records from the giant fibres that these form two systems; the two laterals are interconnected and act in unison independently of the median. Since the discharge from either fibre system may produce the sudden end-to-end shortening of the worm, the question arises why the nerve pathway is double. Stough's answer[4,5] that the median giant will only conduct backwards and the laterals forwards is incorrect, for their action potentials can be shown normally to run both ways[1,3].

A new fact emerges, however, for the sensory field of the median giant is found to be mainly from the first forty segments, and for the laterals from the remainder of the worm (at least in the conditions of the experiments). So it is natural to look for a difference in the two motor responses adapted to escape from attack at the head or at the tail respectively. This is the case.

If the worm is on a slippery surface, the giant fibre response when either head or tail is touched is a shortening towards the middle because (from mechanics) the centre of gravity cannot move. But if the worm is placed on a damp sack where the setæ can grip, it immediately appears that responses are of two kinds. Either the tail is anchored and the head withdrawn, or the head is fixed and the tail brought forward. The first reaction results from touching anterior to the fortieth segment, the second from the region posterior. The protective significance of these responses and their correspondence with the giant fibre sensory fields is obvious.

One other difference in the two responses is easy to see in *Lumbricus*. The median response is accompanied by a characteristic flattening of the tail, the laterally extended edges of which bristle with large setæ directed forward. This reaction is well adapted to grip the sides of the burrow within which the tail usually rests when the worm emerges at night. In the lateral giant fibre response, the tail becomes thin and round in section; hence the two responses are readily distinguished even on slippery surfaces.

Now when at night the worms are extended on the ground with only the tail region in the burrow, they may easily be touched or seized posterior to the fortieth segment. From what has been said it is clear that they should exhibit the lateral giant response, grip with the head and instantly come out of the burrow. This suicidal response never occurs; the worm always appears to exhibit the median giant response, and this no matter what part of the surface is touched.

Clearly observations in the field show a wider range of central connexions than are commonly found under the conditions of electrical recording. It seems that the presence of the tail in the burrow causes some switching over between the two systems. Either the median normally has potential sensory connexions with the body, posterior to segment forty (as indeed some records actually show[3]), which become functional when the tail is in the burrow, or else this attitude causes the lateral giants to activate the motor system used only by the median when the worm is free on the surface. Further observations are needed to settle these and other possibilities.

W. A. H. RUSHTON.

Physiological Laboratory,
Cambridge. May 14.

[1] Bullock, T. H., *J. Neurophysiol*, 8, 55 (1945).

[2] Rushton, W. A. H., *Proc. Roy. Soc.*, B, 132, 423 (1945).

[3] Rushton, W. A. H., *Proc. Roy. Soc.*, in the press.

[4] Stough, H. B., *J. Comp. Neurol.*, 40, 409 (1926).

[5] Stough, H. B., *J. Comp. Neurol.*, 50, 217 (1930).

Cell Contents of Pus

FROM our previous studies entitled "Cell Contents of Milk"[1] we arrived at the conclusion that the fat in milk is secreted by a kind of polymorph neutrophil; as a sequel to this we have investigated the cell contents of pus.

The pus was collected from both acute and chronic cases, and we made wet and dry films, staining as before with methylene blue and May-Grunwald-Giemsa respectively.

We found that, as with milk in the wet films, we could divide the cells into the following three groups.

(1) The group formed by a majority of polymorph neutrophil cells, in pus specimens from acute abscesses. Some of these polymorphs were full of vacuoles which resembled, in some cases, the fat droplets in milk, but the size of the vacuoles varied considerably (Fig. 1).

(2) The second group consisted of mononucle but in the acute pus there was a noticeable abse of the very large cells we found so easily in the n and thyroid fluid. Some of the mononuclears in group contained vacuoles of different sizes, some them being the size of red blood corpuscles.

(3) In the third group are the small mononucle In the chronic abscesses the majority of cells w lymphocytes, which could be seen attached to or two small vacuoles, similar to the lymphocy we found in milk (Fig. 2).

In the dry films also we were able to classify cells, but as in milk, the cells were not in th distinctly different groups, but were linked intermediate cells.

(1) In the first group were numerous polymor containing a large number of empty vacuoles o uniform size. There were also polymorphs w nuclei which appeared to be under pressure becau of the growing vacuoles of different sizes, some them being almost as large as red blood corpuscl These vacuoles appeared to be empty, as the mater contained in them had probably been dissolved the alcohol used in the stain (Figs. 3–5).

(2) The second group contained a wide range mononuclears, and occasionally a very large mon nuclear could be found which had a bluish cytoplas full of empty vacuoles. These mononuclears appear to be very fragile and a large number of the had been broken by the smear (Figs. 6 and 7).

(3) The third group consisted of lymphocytes, a when the dry smear was made from tuberculous pu it could be observed that the lymphocytes still r tained two or three vacuoles in their cytoplas (Figs. 8 and 9).

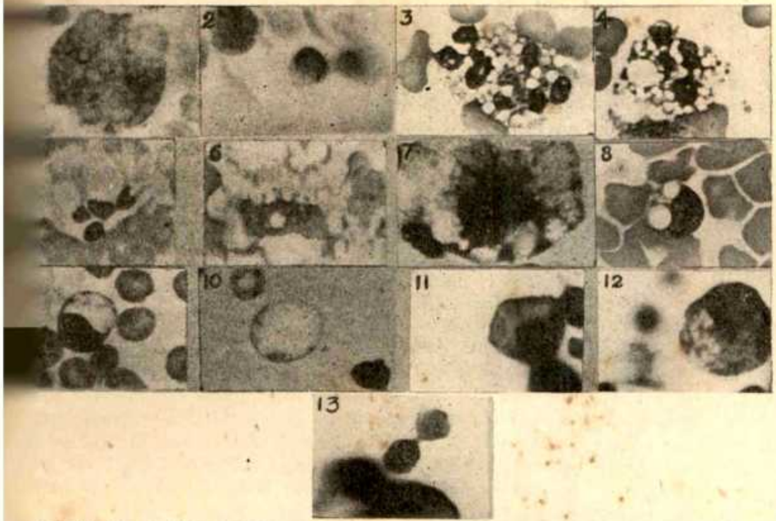
As mentioned above, in all the specimens of p examined there was a noticeable absence of the hu mononuclear cells we had observed in milk and cyst fluid from the thyroids. This can be explained the fact that the pus is not sterile, and includes its composition some very toxic products fro bacterial metabolism and from tissue necros which probably interferes with the full developme of the cells, and consequently there is an absence cells of large size. There are also found in the p some cells which set free portions of their prot plasm, as was observed in milk, and in the same w the liberated portions take on the form of roun drops. Some of the free cytoplasmic portions st framed empty vacuoles (Fig. 10).

Having now confirmed the similarity betwe milk and pus by wet films and dry smears, we studie the histological morphology of different abscesses different tissues.

In sections of granulomas, stained by hæmatoxyl and eosin, and under oil immersion, we were ab to observe a whole range of cells. It was simple follow the evolution from a polymorph neutrop to a larger cell which has been described as a 'foa cell' or lipo-macrophagic cell, then to a small mon nuclear and finally to cells which are similar to t plasma cells. The cells eventually revert to lymph cytes (Figs. 11–13).

The huge mononuclear cells we have observed the milk were also found in the granulomas. Th are present in the edges of the necrotic tissue a not in the pus itself, and this had not interfered wi their development. Occasionally an odd one or tw of these extra large cells float into the pus, only break out and be destroyed when the pus is erupte

It is clear that these large mononuclears prese



WET FILMS. 1. A POLYMORPH FILLED WITH WHAT APPEARS TO BE FAT GLOBULES. 2. A LYMPHOCYTE STILL ATTACHED TO A FAT DROPLET.
SMEARS STAINED WITH MAY-GRUNWALD-GIEMSA. 3, 4. POLYMORPH NEUTROPHILS FULL OF VACUOLES. 5. POLYMORPH CONTAINING LARGE VACUOLES, SOME OF THEM ALMOST AS LARGE AS A RED BLOOD CORPUSCLE. 6. INTERMEDIATE CELL BETWEEN A POLYMORPH AND A MONONUCLEAR. 7. A HUGE MONONUCLEAR FULL OF VACUOLES. 8, 9. LYMPHOCYTES FULL OF VACUOLES. 10. PROTOPLASMATIC REMNANT FRAMING PUS DROPLETS.
FROM GRANULOMA, STAINED WITH HÆMATOXYLIN AND EOSIN. 11, 12, 13. SHOWING THE EVOLUTION OF CELLS IN THE GRANULOMA.

the granulomas originate from a polymorph neutro-il, for they are only an intermediate stage between e polymorph and the lymphocyte, passing naturally rough the stage of mononuclear.

I must thank my technician, Mr. Jeffrey B. Dean, r preparing the photomicrographs.

Conclusions. From our studies of different pus ecimens and granulomas we have formed the llowing conclusions.

(1) The presence of leucocytes is necessary for the rmation of pus, and the pus is not produced from he same tissue in which the inflammatory process is resent, a fact which is already well known.

(2) The material collected and known as pus is a roduct of secretion by the polymorph neutrophil.

(3) The cell which secretes the pus is the poly-norph neutrophil, which by changing its size and uclear structure expels its products and becomes mononuclear, eventually becoming a lymphocyte.

(4) This monoglandular cellular mechanism of pus ecretion is similar to the process of milk fat secretion nd the process seen in the cystic fluid from the hyroid glands.

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April 23.

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[1] *Nature*, **154**, 704 (1944).

Heat Injury in Insects

IN an article on the hardening and darkening of the insect cuticle, Dennell[1] pointed out that both tyrosine and tyrosinase are present in the hæmolymph of late blow-fly larvæ (for example, of *Sarcophaga falculata*), but that darkening does not occur unless the blood is exposed or the larvæ treated with various substances. He went on to suggest that this inhibition *in situ* may involve the action of an unidentified dehydrogenase, the destruction of which results in the onset of tyrosinase activity.

It seems opportune, in this connexion, to give a brief preliminary account of some work on heat injury in blow-fly larvæ (*Sarcophaga falculata* and *Calliphora erythrocephala*). It was found that with a sufficiently refined technique employing short (three-minute) exposures, fully grown larvæ could be so injured by heat that although they recovered from heat dormancy and appeared normally active, death occurred within a few days. The basal oxygen uptake of such larvæ, as compared with untreated controls, showed a considerable increase, accompanied by browning of the tissues, from about a day after treatment.

This seems to indicate tyrosinase activity, which would be in agreement with Dennell's suggestion since dehydrogenases might well be affected by heat treatment. Dennell's original suggestion mentions "tyrosine being reduced as rapidly as it is oxidized" and would seem to involve the continuous oxidation of some reducing substrate in the blood. On this basis there is no reason to expect an *increase* of oxygen uptake to result from destruction of the dehydrogenase. However, Dennell informs me in a private communication that his more recent work on the electrode potential of the hæmolymph indicates that no oxidation of tyrosine takes place until the inhibiting factor in the blood is eliminated. From this it would be expected that in larvæ injured by heat no increased oxygen uptake should be observed until darkening occurs, and these later results agree closely, therefore, with the present observations. Hopf[2] mentions the possibility of heat injury producing enzyme activation in the hæmolymph. Whatever the precise explanation, however, the effect seems to be an upsetting of enzyme balance in the tissues.

Preliminary investigation (mainly by supra-vital staining) of the mitochondria of the fat-body of *Calliphora* larvæ seems to indicate that while those of treated larvæ are small discrete globules, those of controls are generally larger and often aggregated into clumps. If further work confirms this difference, it will be a matter of some interest, as it may well be the mitochondria which first suffer injury by heat.

The various theories of heat injury have been reviewed by Belehradek[3], but only the 'enzyme' and 'lipoid liberation' theories need be considered here. The former proposes that heat injury is due to the inactivation or destruction of enzymes, and seems to have some relevance to the present problem, where heating results in an upsetting of enzyme balance. The widely held 'lipoid liberation' theory postulates the 'liberation' of protoplasmic fats as the cause of heat injury. Among more recent work, that of Fraenkel and Hopf[4] on *Calliphora* and *Phormia* larvæ, while not completely supporting the theory, produced some evidence in its favour.

The mitochondria as the possible site of heat injury provide a link between these theories. They are thought to be bound up intimately with enzyme activity (see reviews by MacBride and Hewer[5], and Bourne[6]), and it is also generally agreed that lipoidal complexes play an important part in their chemical structure (see Bourne, *loc. cit.*). The 'liberation' of mitochondrial lipoids, therefore, might well result in an upsetting of the enzyme systems of an animal and lead to irreversible heat injury. There is evidence in the literature that heat can cause a break-up of mitochondria in a wide range of organisms including plant cells, frogs, fish, guinea pigs and rabbits (see references in Belehradek[3], and MacCardle[7]). It seems possible, therefore, to suggest tentatively that heat injury is due primarily to a break-up of mitochondria and a consequent disruption of enzyme balance. In the case of fully grown blow-fly larvæ, if a dehydrogenase system is truly involved in preserving this balance, its inactivation during heat injury may be through the mitochondria rather than a direct effect of heat.

Part of the work mentioned above was carried out some time ago at the Imperial College of Science and Technology, London. It will be continued, and full details published elsewhere.

G. T. JEFFERSON.

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[1] Dennell, *Nature*, **154**, 57 (1944).

[2] Hopf, *Biochem. J.*, **34**, 1396 (1940).

[3] Belehradek, "Temperature and Living Matter", *Protoplasma Monographien*, 8 (Berlin, 1935).

[4] Fraenkel and Hopf, *Biochem. J.*, **34**, 1085 (1940).

[5] MacBride and Hewer, in Piney's "Recent Advances in Microscopy" (London, 1931).

[6] Bourne, in "Cytology and Cell Physiology" (Oxford, 1942).

[7] MacCardle, *J. Morph.*, **61**, 613 (1937).

Mode of Entry of Contact Insecticides

INVESTIGATIONS now being carried out by us into the use of D.D.T. for the elimination of tsetse (*Glossina* spp.) have led to observations which have a bearing on the mode of entry of some contact insecticides. This problem seems generally to have been considered only in connexion with the usual methods of using contact insecticides, in which the object is to bring the poison, either by spraying or by dusting, into maximal contact with the general body surface of the insect. Mr. Napier Bax has pointed out to us an exception to this, for Tutin[1], so long ago as 1928, does record an observation in which two Carabid beetles and a Cicindelid died after being placed in a dish previously sprayed with an emulsion containing a rape-oil solution of pyrethrum, after the emulsion had dried. Nevertheless, no general attention seems to have been paid to the mere contact of insects with a sprayed surface. Thus Roy and Ghosh[2], discussing as recently as July 1944 various views on the mode of penetration of pyrethrum, and particularly those of Wigglesworth[3,4], record observations which led them to the conclusion that pyrethrum normally enters the insect body through the spiracles.

Our approach has been along the lines of Tutin's observation and therefore somewhat different from the one generally adopted; thus tsetse have been brought into contact with D.D.T.- and pyrethrum-covered surfaces through the feet only, flies being allowed to sit on the prepared surface or held over it with just their feet touching, for various specified periods. Contacts as short as five and even two seconds have proved fatal. One of us (F. L. V.) has demonstrated the presence of particles of D.D.T. on the pulvilli of flies so treated, and from observations on insects with varying degrees of pulvillar development it appears that the action of t
poisons is more rapid when the pulvilli are
developed. Death has followed in the case of D.I
after intervals of half an hour or more, so that
we cannot completely dismiss the possibility
carriage of the poison to the spiracles from the pul
in the flies' efforts to rid themselves of the irritat
particles. But death from pyrethrum has been
graphically rapid that no such explanation is t
able; thus repeatedly tsetse given a few seco
contact with the pyrethrum-treated surface h
become completely paralysed in the interval betw
the removal of the fly from the poisoned surface
the handing of its tube to the recorder for marki
This rapid 'knock-down' action of pyrethrum is,
course, well known, but wears off so rapidly that
contact effect has not much practical applicatic
it is the enduring quality of D.D.T.'s insectici
principle that opens up possibilities of using
contact effect in a practical manner.

The experiments referred to have been carried o
on the haired surface of small pieces of dried cat
hide treated with various strengths of D.D.T. (a
pyrethrum) combined with various adhesive solutic
(such as local gum, serum, wax, resin, etc.) and l
to dry; it is therefore unlikely that any emanati
entering through the spiracles can be held respc
sible for the effect, but further experiments are
be carried out. It is also very noticeable, pa
ticularly with the slower acting D.D.T., that t
first symptoms of actual distress, apart from cleansi
movements of the legs somewhat more persiste
and continuous than usual, are convulsive movemen
of the legs, which suggest that their nervous contr
is the first activity to suffer interference.

Work is proceeding, but these observations
suggest that certain insecticides need not necessari
be applied in such a way as to bring about eith
penetration of the general body cuticle on a larg
scale, or entry through the spiracles; but that the
action can be equally effective through contact
the feet alone, at any rate in species with wel
developed pulvilli.

W. H. POTTS.
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Department of Tsetse Research,
Shinyanga.
April 13.

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[1] Tutin, F., Ann. Rep. Agric. and Hort. Res. Station, Long Ashton, Bristol, 1928, 96.

[2] Roy, D. N., and Ghosh, S. M., *Bull. Ent. Res.*, **35**, 161 (1944).

[3] Wigglesworth, V. B., *Proc. Roy. Ent. Soc. Lond.*, **16**, 11 (1941).

[4] Wigglesworth, V. B., *Bull. Ent. Res.*, **33**, 205 (1942).

Congo Red Fibrin Powder for Experiments on Proteolytic Enzymes

STAINED fibrin substrates are sometimes used for experiments on proteolytic enzymes. Grutzner[1] used fibrin stained with carmine to estimate the amount of pepsin in a solution. Carmine fibrin cannot be used for testing for trypsin as the dye is dissolved out of the fibrin by alkalis. The difficulty was overcome by Roaf[2], who as early as 1908 used Congo red instead of carmine. Congo red is not dissolved out of the stained fibrin by hydrochloric acid or by sodium carbonate, and can thus be used for experiments on both trypsin and pepsin. Roaf first used a moist preparation which was preserved in equal parts of glycerol and water to which a little toluene was added. Later[3] he used Congo red fibrin in the form of a dry powder, in which condition it kept well. Very little attention seems to have been paid to Roaf's work. Cole[4] describes the use of carmine fibrin for an experiment on pepsin but does not mention Congo red fibrin. Hawk[5] suggests the use of carmine fibrin for pepsin and Congo red fibrin for trypsin. These are both moist preparations which have to be preserved under ether or glycerol. The advantages of a dry stable powder which can be used for both pepsin and trypsin are obvious.

About a year ago, unaware of Roaf's work at the time, we prepared a Congo red fibrin powder which has proved very satisfactory for students' experiments on proteolytic enzymes. Our method of preparing the powder is similar to Roaf's method.

The powder has been incubated at 37·5° C. for twenty-four hours in 0·2 per cent hydrochloric acid and in 0·5 per cent sodium carbonate without any of the colour coming out. Incubation at 37·5° C. in 0·05 per cent sodium hydroxide, however, resulted in a faint pink colour at the end of one hour. Peptic digestion gives a blue violet and tryptic digestion a red solution.

Preparation. (1) Wash some fresh fibrin in running tap water for several minutes. Transfer to a beaker of water and heat to about 70° C., stirring at intervals. Strain through muslin and rinse well in running water. (2) Mince the fibrin and put in slightly alkaline Congo red solution (450 c.c. distilled water; 50 c.c. 96 per cent alcohol; 0·2 c.c. 2 per cent ammonia; 2·5 gm. Congo red. 500 c.c. is used for every 100 gm. fresh moist fibrin). Heat to 80° C., stirring at intervals. Strain through muslin and wash in running tap water. (3) Place in a beaker of water which has been made alkaline to phenolphthalein by the addition of 2 per cent sodium carbonate. Heat to about 70° C., stirring at intervals. Strain and wash thoroughly in running tap water until the washings are colourless. (4) Spread the stained fibrin on filter paper and dry in an oven at 60° C. (5) Grind to a powder in a mortar. (6) Cover the powder with acetone and stir at intervals for five minutes. Pour off the acetone, spread the moist powder in a thin layer on filter paper and allow to dry.

About 10 gm. of powder are obtained from 100 gm. of fresh moist fibrin.

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Department of Physiology,
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March 16.

[1] Grutzner, *Pflüger's Arch.*, **8**, 452 (1874).

[2] Roaf, *Biochem. J.*, **3**, 188 (1908).

[3] Roaf, *J. Physiol.*, **53**, lxvii (1920).

[4] Cole, "Practical Physiological Chemistry", 9th ed., 226 (Cambridge: W. Heffer and Sons).

[5] Hawk, "Practical Physiological Chemistry", 11th ed., 287 and 323 (London: J. and A. Churchill).

Action of Mepacrine on Diamine Oxidase

THE observation by Hammick and Chambers[1] that 2-chloro-5-amino-7-hydroxyacridine is a breakdown product of mepacrine found in human urine shows that the side-chain of mepacrine is removed by the scission of a C—N linkage.

In this connexion it seems of interest that the drug has a marked affinity for the enzyme diamine oxidase. Using an acetone-dried preparation of pig's kidney and $5 \times 10^{-3} M$ cadaverine as substrate, we find that mepacrine depresses the oxygen uptake due to oxidation of cadaverine. The inhibition with $10^{-3} M$ mepacrine dihydrochloride was 92 per cent, with $10^{-4} M$ and $10^{-5} M$, 82 per cent and 45 per cent respectively.

The affinity of mepacrine for the enzyme is only in part due to the presence of the side-chain. In an experiment in which mepacrine was compared with 2-chloro-5-amino-7-methoxyacridine (kindly given to us by Dr. D. Ll. Hammick and S. F. Mason), that is, the compound corresponding to mepacrine without the side-chain, the inhibitions—in $10^{-4} M$ concentration—were 70 per cent with mepacrine and 33 per cent with the amino derivative.

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RUTH DUTHIE.

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May 7.

[1] *Nature*, **155**, 141 (1945).

Effect of Alpha-Ray Bombardment on Glide in Metal Single Crystals

THERE are many indications that surface imperfections of the crystal lattice play a marked part in the initiation of the glide that results when single crystals are subjected to stress. Orowan[1] and others have discussed the matter from the theoretical side. From the experimental side, Roscoe[2], working in my laboratory, has shown that a very thin oxide film on the surface produces an increase in the resistance to plastic deformation, which cannot be due to the cohesion of the film, and Rehbinder[3] has shown that very thin surface films of certain substances, applied to single crystals, produce striking effects.

In order to throw light on the part that the surface plays in glide, I have been bombarding stressed single-crystal wires of cadmium with α-rays from a strong polonium source, deposited on the inside of a nickel cylinder 1 cm. long, which is split longitudinally so that it can be made to surround the wire. It was thought that the intense temperature agitation produced by the impact of a particle would, when the particle struck the metal in the immediate neighbourhood of a minute surface crack or dislocation, initiate glide. The α-particles, which penetrate about 0·005 mm. into the metal, cause considerable local disturbance, but under the experimental conditions do not produce appreciable bulk heating. Direct experiment proves that with my disposition the rise of temperature at the axis of the wire does not exceed 0·01° C.

The preliminary results of these experiments show that when a wire is stressed so as to produce a slow creep, of the order of 0·05 per cent per minute, bombardment with α-particles causes the rate of flow to increase to several times the value which obtained before the bombardment—five times in one particular case—although the wire was bombarded over only one third of its length. The wire had been extended by about 1 per cent when the bombardment was initiated. In the case of another wire which had been extended by 2·6 per cent of its length, and was increasing its length at a rate of 0·21 per cent per minute, bombardment increased the rate by about three times.

The greater the preliminary extension which had taken place before the bombardment, the smaller the effect of the α-particles. After an extension of 3 per cent, when the rate of flow was markedly decreasing owing to the usual hardening effect, the bombardment caused but a small, although definite, change in the rate. With a wire that had been extended by 12 per cent, and was flowing at the rate of 0·7 per cent per minute, bombardment did not affect the rate of flow. Incidentally, this confirms that there is no appreciable bulk heating.

The above figures are given as indications that the effect is considerable: no precise quantitative significance is to be attached to them, since the strength of the source has not been accurately measured nor the inclination of glide plane and glide direction determined. Owing to the destruction of this laboratory during the air attacks, facilities are at present lacking for any such measurements. What the experiments show clearly, however, is that glide on particular planes can be initiated by α-ray bombardment, and hence that initiation of glide takes place from the surface. Once a particular plane is active, glide continues at a rate independent of the surface disturbance, as shown by the fact that bombardment does not affect the rate after large preliminary strain when, presumably, all suitable glide planes are in action. The α-particle bombardment is, then, a useful index to show whether glide is taking place by the activation of new glide planes or is continuing on planes already in action. In this connexion it can also be made to throw light on the mechanism of hardening, as discussed, for example, in a paper by Andrade and Chow[4].

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[1] For example, *Z. Phys.*, **89**, 605, 614, 634 (1934).

[2] *Phil. Mag.*, **21**, 399 (1936).

[3] The papers describing Rehbinder's work were given to me on my recent visit to Russia, but I have mislaid them and hence cannot give the reference. I hope later to write a note in *Nature* describing this very interesting work.

[4] *Proc. Roy. Soc.*, A, **175**, 290 (1940).

A New Approach to Relativistic Cosmology

THE kinematical part of relativistic cosmology concerns the most general line-element which satisfies the conditions of homogeneity. It has the form

$$ds^2 = d\tau^2 - R^2(\tau)d\sigma^2 \quad . \quad . \quad . \qquad (1)$$

where $d\sigma^2$ is the line element of a three-dimensional space of constant curvature k: 1, 0, − 1.

It is *always* possible to change (1) into the form:

$$\begin{gathered} ds^2 = \gamma\,(r,t)(dt^2 - dx^2 - dy^2 - dz^2) \\ r^2 = x^2 + y^2 + z^2 \end{gathered} ; \quad . \quad . \qquad (2)$$

The form (2) is more general than (1) and to make (2) equivalent to (1) requires additional restrictions concerning γ. It would seem that the transition from (1) to (2) is purely formal, and that nothing can be gained by a discussion of cosmological problems on the metrical background (2) instead of (1). However, this is not so. To show it we shall formulate some conclusions following immediately from (2):

1. The light geometry of any cosmological space (in (2)) is identical with that of a Minkowski space.

2. Any cosmological space can be looked upon as a Minkowski space with a non-Minkowski gauging. This is clear if we regard γ as the gauging factor in Weyl's sense. Thus, the most general cosmological space can be pictured as a Minkowski space in which the length of a vector changes by transportation, though in an integrable way.

3. The solution of Maxwell's equations in a cosmological space is identical with that in a Minkowski space. This can be deduced from the gauge invariance of Maxwell's equations, or from the fact that neither f_{kl} nor $\sqrt{-g}\,f^{kl}$ nor the structure of Maxwell's equations contains γ. The radiation spreading through the zero-cone is insensitive to any changes in γ. This simple conclusion seems to be unknown. Until recently papers were written on the solution of Maxwell's equations in a cosmological world. What the authors really found was a solution in a Minkowski space complicated by the choice of a co-ordinate system convenient for the description of motion of particles but very inconvenient for the description of an electromagnetic field.

4. The same holds true for Dirac's equations. They are, like Maxwell's equations, insensitive to the choice of γ. Or, rather, they must be expressed in a form such that they will be gauge invariant in the above sense. Again, papers dealing with Dirac's equations in a cosmological space give results apparently different from the old ones because of an inconvenient choice of a co-ordinate system.

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Infra-Red Spectrum of the Night Sky

WE photographed the infra-red spectrum of the night sky by means of a spectrograph with two prisms having an aperture of $f/1 \cdot 5$, giving a dispersion of 2000 A./mm. near 8000 A. and of 3000 A./mm. near 10000 A. We used the only infra-red plates we had at our disposal, namely, "800" AGFA plates; we sensitized them before exposure. A ten-hour exposure made at the end of February 1942 at the Lyons Observatory gave us a spectrum[1] showing:

(1) A broad band without any visible structure, stretching from λ 7400 A. to about λ 8500 A., with a notable fall of intensity beyond λ 8200 A.; according to the earlier observations made by Cabannes[2], it appears to be the first positive system of the nitrogen bands, the *A* oxygen band and the water-vapour bands.

(2) A very broad band at about 0·97 μ and a line or band about 1·03 μ. Since the limit of sensitivity of the plates we used is normally about 0·85 μ, an image much beyond 0·9 μ is possible only if there is in the night sky an unusually intense emission in this spectral region.

The broad band about 0·97 μ is probably the 0·94 μ water-vapour band. As to the 1·03 μ radiation, we considered two possible origins: either the (0,0) band of the first positive system of the nitrogen bands (wave-length of the head, 1·042 μ) or the forbidden doublet $^2P - {}^2D$ of the N I atom (λ 10410 A.–λ 10401 A.). In fact, on one hand, the (0,0) band of the first positive system can quite well be seen alone in the infra-red region observed because of its strong relative intensity[3]; the existence of the (0,0) band of the first positive system would fit in with the fact that most of the bands of this system have been found both in the visible and in the distant red[2]. As to the infra-red [N I] doublet, we have just heard through a private letter from an American colleague that its permanent presence in the spectrum the night sky has been indicated recently, and at its intensity would exceed that of the green line [O I]. This fact, important for the physics of the pper atmosphere, confirms the ideas recently exunded by one of us[4], who showed that nitrogen ust be found essentially in the atomic state in the pper atmosphere. But it remains possible that the vo identifications that we suggest may be simulneously true; moreover, the two emissions may e bound together by a mechanism one of us has ready pointed out[5]: the (0,0) band of the first ositive system corresponds to the $B_0 - A_0$ transition f the nitrogen molecule; now the presence of the egard-Kaplan bands in the radiation of the night y leads us to admit the presence of numerous A_0 olecules in the upper atmosphere; through the ollision between the A_0 molecules and the ^2P atoms e can have the following process:

$$\underbrace{\overset{A_0}{6{\cdot}14\text{ v.}} + \overset{^2P}{3{\cdot}56\text{ v.}}}_{9{\cdot}70\text{ v.}} \rightarrow \underbrace{\overset{B_0}{7{\cdot}32\text{ v.}} + \overset{^2D}{2{\cdot}37\text{ v.}}}_{9{\cdot}69\text{ v.}}$$

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Herman, R., Herman, L., and Gauzit, J., "Cahiers de Physique" No. 12, 46 (1942).
Cabannes, J., *J. Phys.*, **5**, 601 (1934).
Poetker, A. H., *Phys. Rev.*, **30**, 823 (1937).
Gauzit, J., *C.R. Acad. Sci.*, **213**, 695 (1941); "Cahiers de Physique", No. 9, 47 (1942).
Herman, Mme. R., *C.R. Acad. Sci.*, **212**, 120 (1941).

Behaviour of Ultra-Violet and Daylight Rays in the Solar Cycle

WHEN graphs are constructed, for the sunspot cycle 1933–44, of the annual averages both of ultra-violet and of daylight rays, they are found to have a decisive *minimum* at the sunspot *maximum*, of 1937–38, and the drop from maximum to minimum of the daylight curves is approximately twice as large as that of the ultra-violet curves. This drop of the rays received at the time when the sun has its highest activity, as shown by the maximum number of spots, suggests that the rays emitted from the sun are in part absorbed in their passage to the earth by some agency which fluctuates with the sun's activity and is most effective at the time of maximum sunspots. The ionization of the upper air due to ultra-violet rays is a probable agency in producing this effect.

While the daylight rays show an inverse relation to the sunspot curve and have a period the same as the sunspots, the ultra-violet rays exhibit two weak maxima on either side of its minimum and the curve appears to have a double period in the solar cycle. An explanation of these observations can be given on the following lines.

As regards the daylight rays, if they are not subject to any large fluctuations on emission from the sun, but are impeded in their passage to the earth by an agency of period like that of the sunspots, such as ionization of the upper air, they will have a single period in sympathy with the solar cycle. If, on the other hand, rays such as ultra-violet rays coming from the sun are subject to sunspot activity and fluctuate with it, and if these rays generate the fluctuating ionization already referred to, which at the same time acts as an absorbing agent, then the ultra-violet rays received on the surface of the earth would at first *increase* with growing sunspots; but at an early stage in the cycle the impeding ionization would reduce their intensity and a point would be reached when they would begin to *diminish* and continue to do so as far as their minimum when ionization is greatest; after which a reverse action would ensue, the rays would *increase*, due to reduction of ionization, and at a later stage they would diminish as their emission from the sun fell off, and two weak maxima would be presented one on each side of the droop of the curve. Thus the single period of the daylight rays coinciding with the period of the solar cycle would be explained by the emission of rays nearly constant over the solar cycle, while the double maximum of the ultra-violet rays would occur if the rays are not emitted uniformly but are subject to a fluctuation in sympathy with the sun's activity.

One result of this point of view is that at an early stage and again at a later stage in the solar cycle the received daylight and ultra-violet rays should move in opposite directions. In the latter part of the solar cycle of 1933–44 this comes out clearly, daylight rays increasing and ultra-violet rays decreasing simultaneously.

At the present time, sunspots are a minimum and there will probably be a rapid increase in their number in the next three or four years. These years will be of the highest interest in verifying or, if necessary, modifying the conclusions derived from the observations made during the solar cycle of 1933–44.

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Inverse Binomial Sampling

IN a recent communication discussing the application of the sampling method described by Haldane[1], Tweedie[2] states that the method was described as a technique for using hæmocytometers. This is not so. Hæmocytometers are designed for estimating the population density per unit volume, and the method under discussion is adapted for estimating the incidence of an attribute in a population consisting of members possessed of that attribute and members not possessed of it. This is an entirely different problem. The method, which has been in use in this Laboratory for a considerable time, and has proved of great value, was designed for estimating the incidence of certain abnormal forms of erythrocytes in blood films, this incidence often being as low as 0·2 per cent. By using this sampling technique, increased accuracy is obtained at these low incidence levels, and a saving of time and labour occurs at high incidence levels.

As both Haldane and Tweedie indicate, the method has much wider applications than to hæmatological estimations, but it does not extend to the hæmocytometer type of sampling.

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April 27.

[1] Haldane, J. B. S., *Nature*, **155**, 49 (1945).
[2] Tweedie, M. C. K., *Nature*, **155**, 453 (1945).

Geology of the Nubian Sandstone

THE manner of formation of the famous Nubian sandstone has been a matter for controversy for a century. This may be partly attributed to its wide geographical distribution (extending over 30° of longitude and 20° of latitude)[1], its great vertical range (ranging from Palæozoic to Mesozoic), lack of fossils in its greater part, monotony of its lithological characters, and the difficulties entailed in the investigation of almost inaccessible localities in which it outcrops. The problematical unfossiliferous sands and sandstones in representative localities of the Eastern Desert of Egypt and in south-west Arabia were recently examined[2,3], using some of the more recent technique of sedimentary petrology.

Field observations, comprising (*a*) the upward transition from sands to clays to limestones, on a large scale, especially in the Cretaceous Nubian Sandstone; (*b*) the lateral extension and constancy of its sandy beds over large areas and the regular stratification; (*c*) the presence of water-ripple markings with a ripple index of 8·4; (*d*) the presence of a current-bedding similar to that described by McKee[4], with horizontal and inclined laminæ at 26° with the horizontal; (*e*) the presence of bands of transported quartz pebbles of spherical and discoidal shape (their sphericity ranges between 1·00 and 0·57 with 76 per cent of the pebbles having a sphericity which lies between 0·80 and 0·60); and (*f*) the regular surface of contact between the pre-Cambrian and the Nubian Sandstone, indicate that the sandy facies of the Nubian Sandstone of the different ages represent beach and off-shore shallow marine deposits of a sinking peneplained land-mass, excluding the possibility of an æolian origin or their formation under fluviatile, lacustrine, deltaic or estuarine environment.

Mechanical analyses of some eighty samples of the sandy facies showed that the sediments are remarkably uniform and are very well sorted. This sorting suggests either a beach or a dune formation. The histograms given by the Nubian Sandstone, however, are similar to those of modern beach and near-shore shallow-water sands (giving what we may term a 'one-bar' histogram, in which the percentage of the largest fraction is more than 60 per cent and differs from the other percentages by at least 25 per cent, using the Wentworth scale) and are different from those of recent dunes (which may be termed 'two-bar' histograms, in which the difference between the percentages of the largest two fractions does not exceed 25 per cent). This may be taken as a further indication of the marine origin already inferred for the sandy beds.

The mineralogy of some seventy samples from the sandy facies (and of some intercalated clayey and calcareous beds at Khashm-el-Galala, south of Suez) showed that post-depositional dissolution of the minerals was at a minimum (perhaps noteworthy in the light of work in other parts of the world), notwithstanding the old age of the deposit, and the presence of etched grains and certain authigenic minerals. This conclusion is based on the following observations: (1) the presence of the same minerals in the same abundance in the various lithological varieties; (2) the presence of fresh grains of the easily hydrolysed hornblende and augite in the formation; (3) the presence of etched and unetched grains of garnet side by side in the same hand-specimen; (4) the presence of etched staurolite and etched colourless epidotes in the sealed and stabilizing media of the clays and limestones, denoting that the etching is not, in the present case, a criterion of post-depositiona changes. This question of post-depositional change in the Nubian Sandstone is, at present, under detaile investigation.

The mineralogical study showed also that the formation is, in the main, composed of the sam minerals in the same abundance both in a vertica and horizontal sense, which prohibited zoning and thereby correlating the formation on a large scale This lateral uniformity of the mineralogy of the formation in the localities examined points to wind transportation, because such uniformity seems to be a criterion of marine sediments carried by wind[5]. The frosting of most of the quartz grains and their spherical and rounded nature lend evidence for the suggestion; the marine environment previously inferred was not given enough time to polish the grains The detrital minerals have been mostly carried by wind, but they must have been deposited and redistributed under water.

It is, therefore, necessary to abandon the conclusions of Walther[6] and of Fourtau[7], who advocated an æolian (continental) origin for the Nubian Sandstone, a conclusion which gradually crept into some of the general works on stratigraphy[8] and which is held by some of the more recent and leading workers[9,10] on the stratigraphy of the Middle East countries.

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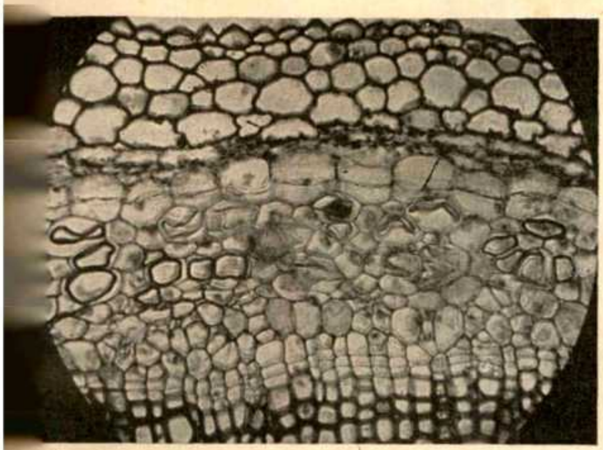
An Endodermal Phellogen in the Stem of *Paederia foetida* Linn.

DURING the course of an anatomical study of *Pæderia fœtida*, a twining shrub of these parts, belonging to the family Rubiaceæ, we found that the phellogen originates in the stem, not in the sub-epidermal layers of the cortex as in most dicotyledons, but in the endodermis. We have seen this in a large number of sections, cut free-hand as well as on the microtome, from various collections of the material made at Dacca. The endodermis itself is a clear and unmistakable layer easily recognized by the presence of the Caspary bands on its radial walls and forming a continuous cylinder enclosing the stelar tissues. After the first tangential division of its cells the inner layer functions as the phellogen, and the outer, together with the whole of the cortex and the epidermis, is sloughed off as cork formation advances. We would like to know if a similar condition has been noticed in any other plant and what may be the causal factors leading to it. This observation is recorded here in the hope that it will attract the attention of other plant anatomists.

We are, of course, aware of instances where the



TRANSVERSE SECTION OF STEM OF *Pæderia fœtida* SHOWING TANGENTIAL DIVISION OF CELLS OF THE ENDODERMIS. (× *c*. 220)

hellogen is formed in the epidermis, cortex or pericycle, as also a couple of cases of interxylary cork ormation and one of cork formation on the endoperm. It is also well known that in *Quercus suber*, he cork oak, the cork cambium first arises in the pidermis, but, due to the frequent strippings of ork, it may later arise in tissues lying considerably leeper, even as far down as the secondary phloem. The case of *Pæderia* is, however, quite different, for here the cork cambium arises at the very outset in the endodermis and is recognizable while the stem is still quite young. The cork which it forms is permanent and there is no deeper-lying phellogen differentiated afterwards unless the stem is wounded.

The accompanying photomicrograph shows the tangential division of the endodermal cells into two layers, of which the inner is to function as the phellogen.

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April 21.

Synthesis of Adenosine Triphosphate by an Enzyme System from Ischæmic Muscle

WHILE investigating the changes in phosphates of muscle in tourniquet shock, Bollman and Flock[1] have confirmed and amplified our previous finding (Green)[2] by showing that the adenosine triphosphate content of rat muscle falls progressively after clamping of the limb to reach a very low level at the time (four hours) at which, when both limbs are involved, fatal shock develops after release. They conclude that "this type of shock is definitely not due to ATP washed out of the muscle because ATP is destroyed during the occlusion and its decomposition products appear to be relatively non-toxic". In our opinion, the results of Bollman and Flock[1] only allow the conclusion that tourniquet shock is not due to a sudden release of adenosine triphosphate into the circulation on removal of the clamp. We never considered it likely that this was the mechanism, since a single dose of adenosine triphosphate injected intravenously produces acute symptoms and not the gradual merging into a shock-like state seen in ischæmic shock and after injection of adenosine triphosphate by routes other than the intravenous[2].

Extensive studies have shown the difficulty of detecting chemically the presence of adenosine triphosphate or its breakdown products in the blood of rats following the injection of lethal doses. Failure to detect it in the blood of rats during ischæmic shock is not therefore proof that it plays no part in the syndrome.

The problem was tackled at another angle. It was postulated[2] that resynthesis of adenosine triphosphate might occur in the limb muscle after release of the clamp, and that it would escape continuously from the damaged muscle cells and leave the limb. Bollman and Flock's conclusion would only be justified if there were evidence of the failure of the enzyme systems of ischæmic muscle to resynthesize adenosine triphosphate. Accordingly we studied the activities of isolated enzyme systems from the normal left- and the ischæmic right-leg muscles of six rats. The findings were precisely similar in each instance.

COMPARISON OF ACTIVITIES OF ENZYME SYSTEMS FROM NORMAL AND ISCHÆMIC RAT MUSCLE.

	Age of enzyme preparation	Normal muscle	Ischæmic muscle
Transmutation : Phosphopyruvic acid P/ml.	2 days 8 days 3 weeks	0·038 0·036 0·031	0·037 0·035 0·032
Resynthesis of adenosine triphosphate P γ/ml.	2 days 8 days 3 weeks	— 0·031 0·012	0·037 0·028 0·013
Deamination : % NH_2–N of added adenylic acid	1 day 2 days	79·9% 80·8%	79·2% 79·7%

A : Transmutation and Resynthesis : Normal muscle and muscle taken from below unreleased clamp after four hours application. Enzyme solutions made up to correspond to 2 gm. of fresh tissue per ml.
B : Deamination : Tissue residue from corresponding preparations *A* treated according to Lohmann and Schuster (ref. 6). Bicarbonate extracts corresponding to 1 gm. of fresh tissue per 3 ml.

As will be seen in the table, the resynthesis of adenosine triphosphate from muscle adenylic acid and phosphoglyceric acid, involving the transmutation of the latter compound into phosphopyruvic acid (Baranowski)[3], as well as the activity of Schmidt's[4] muscle adenylic acid deaminase, were of the same intensity with enzymes prepared from both ischæmic and normal muscle. This strict parallelism held true, not only for fresh, but also for enzyme preparations which had been stored in the refrigerator for different lengths of time.

Since the enzyme systems responsible for the resynthesis of adenosine triphosphate are intact in ischæmic muscle, why, as Bollman and Flock[1] have shown, does the adenosine triphosphate content of the muscle remain at a low level for a considerable time after removal of the clamp ? The reason may be that though the synthesis of adenosine triphosphate will begin once the oxygen supply and ionic concentrations are approaching normal levels, the damaged muscle is unable to store the adenosine triphosphate produced. Such a hypothesis would account not only for the continued low adenosine triphosphate content of the damaged muscle, but also for the slow development of the shock-like state which develops after the release of the tourniquet and which strongly resembles the state following the intramuscular injection of adenosine triphosphate.

Bollman and Flock[1] found that muscle fibres, which have been damaged by vascular occlusion for four hours, take several days to return to normal, and we should not expect the adenosine triphosphate content to reach the normal level before the contractile element of the muscle fibres has been restored (Szent-Györgyi)[5].

These experiments throw no direct light on the role of adenosine triphosphate in ischæmic shock, but they do show that it cannot be ruled out as a possible factor.

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Amœbiasis in Durban

IN Durban there is a reversal of the customary incidence of amœbiasis. It is generally stated that an indigenous population is less susceptible to this disease, but in Durban the native African is much more liable than the European or Indian to acute, fulminating amœbic dysentery. In Europeans the condition is usually chronic, with an accent on the vague manifestations. When there is dysentery in Europeans it is usually of the 'walking' type, whereas in Africans the patient is prostrate. Examination of the stool in African cases shows the cytology of an acute bacillary dysentery, without macrophages, but with myriads of large, actively motile, hæmatophagous trophozoites of *E. histolytica*. In fact, as many as 150 parasites have been counted in a single high-power field. The amœbæ are so motile that they are streaked out often with a tail of dragging detritus. The customary distinction between ecto- and endoplasm is not clearly seen in fresh preparations, for the granular material moves into a pseudopod almost as quickly as this is formed, and it is only in older specimens that clear ectoplasm is obvious.

Amœbiasis in Africans has a high morbidity and mortality, for in 1944 there were 1,203 proved cases at King Edward VIII Hospital, with 198 deaths.

Opinions differ as to the reason for this 'racial' susceptibility. The African has been incriminated as the source of amœbiasis here, but rather is it the reverse, for the African is probably meeting a new disease, judging by the severity of the infection.

This manifestation of amœbiasis is probably due to a number of factors: (1) Contact between a susceptible race and a race with a high host-parasite equilibrium. (2) The nature of the African diet, particularly in urban areas and under war-time conditions. This diet is almost exclusively carbohydrate, which is definitely conducive to infection. It may be that there is a sub-clinical intestinal pellagra rendering the bowel wall particularly susceptible to invasion. (3) In rapid passage from individual to individual the amœba gains virulence. (4) The insanitary conditions in which the detribalized native lives around the towns offering employment. The parasite may in part be water-borne, for there is always an exacerbation when the local streams begin to run after the rains. Possible vectors such as flies and cockroaches are numerous, and there can be no doubt that dire transmission takes place. Vegetables as a mediu are not important; for the African under tow conditions gets little of these.

Further work is being done on this problem, an will be reported in due course.

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An Illusion of Size

I READ Dr. Loewenstein's letter[1] with the abov title with great interest and began by repeating th tests which he describes. I took a bright nickel three penny piece (1944) and polished it; I took also very dull one which was minted during 1937. placed them on a black background and at once saw as Dr. Loewenstein states, that the older one appeare the larger.

Being somewhat puzzled by this observation, I measured the two coins and this is what I found diameter angle to angle, old coin 3·075 mm., new coin 3·060 mm.; diameter, flat to flat, old coin 3·01 mm., new coin 3·00 mm.; surface, inside raised edges, old coin 2·72 mm., new coin 2·66 mm. Thus in each case the older coin is the larger. These measurements were made with ordinary engineer's gauges. The accuracy was, however, sufficient to establish the fact that the old coin is in certain respects physically larger than the new one. An examination of coins minted in the year 1938, 1939, 1941, 1942 and 1943 indicated that the change in size occurred in between 1939 and 1941. I tried to obtain a coin for 1940 but without success.

Two 1937 coins of the same size were now selected, a dull one and a polished one, and these were placed as before on a black background. With perpendicular lighting the dull one appeared to be either the same size or slightly smaller than the bright one, presumably due to retinal irradiation produced by the latter. With oblique lighting, on the contrary, the dull one sometimes appeared to be slightly larger than the bright one. This seemed to be due to the bright reflexion from the raised edge of the polished coin being somewhat smaller (since the light was reflected from the outside of the raised edge on one side of the coin and from the inside of the raised edge on its other side) than the matt reflexion from the raised edges of the unpolished one. Very careful adjustment of the oblique lighting had to be employed in order to obtain this effect, for otherwise the coins appeared the same size, or the dull one the smaller as with perpendicular lighting.

So far as I can see from these experiments, it is unlikely that the effect described by Dr. Loewenstein is a psychological one. It is either due to an actual difference in size of the two coins or to the way that light is reflected from them. It would be interesting to know if in his experiments Dr. Loewenstein measured the coins to see whether or not they were identical in size.

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COLOUR SENSITIVITY OF THE FOVEA CENTRALIS

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AST year, one of us (E. N. W.[1]) demonstrated that a small central area of the fovea was unable discriminate blue-green colours and, in other ways lso, appeared to have the characteristics of the itanopic form of colour-blindness. The observations ere made with small painted test spots suitably xated on the foveal centre. The results aroused onsiderable interest and led to correspondence in Jature[2,3,4,5], in which it was pointed out that König[6], some fifty years ago, had noted that his oveal centre was tritanopic: his observation, how-ver, did not appear to have been generally accepted[7].

A full description of the colour vision of any retinal area requires the measurement of the luminosity curve, the spectral mixture curves and the hue discrimination curve for that area. From data of this type it should be possible to derive information about the spectral sensitivity curves of the retinal receptors and, in the case of the central fovea, to compare these curves with corresponding results for other retinal areas.

The results described below were obtained with the colorimeter previously developed by one of us (W. D. W.[8]) with which colour matching, hue discrimination and luminosity measurements can all be made. The test and comparison fields formed the two halves of a small circular field which, in most of the observations, subtended about 20′ of arc: some measurements were also made with 12′ and 15′ fields. The exit pupil of the apparatus as normally used is about 1 mm. diam., but for most of the final observations the system was modified to permit a larger pupil, about 2 mm. diam., to be used. The observer's head was fixed by a dental impression mouthpiece in such a way as to bring the exit pupil of the apparatus on to the optical axis of the observer's eye. The brightness of the field was of the order of 100 photons, although various brightness levels were used from time to time, and at the violet end of the spectrum the level was necessarily lower.

König's observation that colour matching in the foveal centre could be carried out with only two matching stimuli was confirmed, and Fig. 1 shows the dichromatic coefficient curves for the spectrum for W. D. W., using matching stimuli of wave-lengths 0·65 μ and 0·46 μ. The units of the stimuli were so chosen as to be equal in the match on a yellow at wave-length 0·5825 μ, and the values for the red (r) and blue (b) coefficients in any match were adjusted to bring $r + b = 1$. For the advantages of this type of unit system, reference may be made to previous papers[9,10]. It will be noticed that, with the matching stimuli used, all the spectral colours could be matched by positive mixtures of 0·65 μ and 0·46 μ. At wave-lengths shorter than 0·46 μ, the ratio of red to blue in the mixture increased; this corresponds, in trichromatic vision, to the increase in the amount of red required to match the violet radiations. The increase also means that there are pairs of wave-lengths on either side of some point between 0·45 μ and 0·46 μ (the exact wave-length of the minimum of the red curve, or the maximum of the blue, is difficult to determine) which match each other in colour quality. These matched wave-lengths may be determined by drawing a horizontal line such as AB in Fig. 1 and finding the wave-lengths at which the line intersects the red curve.

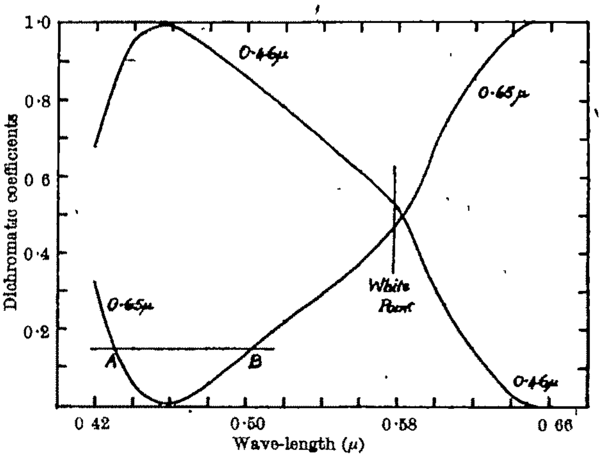

Fig. 1. DICHROMATIC COEFFICIENT CURVES FOR W.D.W. White point at 0 578 μ. A and B, spectral colours which match each other.

The fact that vision is dichromatic implies (see Pitt[10,11], for example) that all stimuli, homogeneous and heterogeneous, can be matched by the appropriate mixture of the two matching stimuli and also, therefore, by some monochromatic radiation. In particular, there is a neutral point in the spectrum at which a white of some defined quality can be matched by the spectral radiation at that point. With a white stimulus having a colour temperature of 4,800° K., the neutral point for the central fovea was located at a wave-length of 0·578 μ. This is a mean value obtained from direct matches between the white stimulus and a radiation from the spectrum, and also from matches between the white and a mixture of the matching stimuli, 0·65 μ and 0·46 μ. Direct observation, supported also by the coefficient curves, indicated a second neutral point in the region of 0·41 μ, but the brightness at which the observations could be made was too low for the point to be determined with certainty.

The luminosity curve was recorded by measuring the energy at wave-length λ required to match a comparison field of constant brightness and quality. The inverse of these energy values plotted against λ then yields what is generally known as the equal-energy luminosity curve. The curve so obtained for the 20′ field is shown in Fig. 2, with a curve for a 2° field drawn for comparison. In making the observations, a red comparison field was generally used to assist foveal fixation. No great difference between the two curves is apparent, although at the short wave-lengths the luminosity values for the smaller field are only about half those for the larger field, while in the region of 0·61 μ a slight hump is revealed. At lower brightness levels, a more pronounced hump has been previously recorded[12] with a 2° field and a small peak with 20′ fields[13].

The coefficient curves can be converted from the unit basis of Fig. 1 to luminosity units by measuring the relative luminosities, L_R and L_B, of the amounts of 0·65 μ and 0·46 μ required to match 0·5825 μ, the wave-length chosen to define the units of the matching

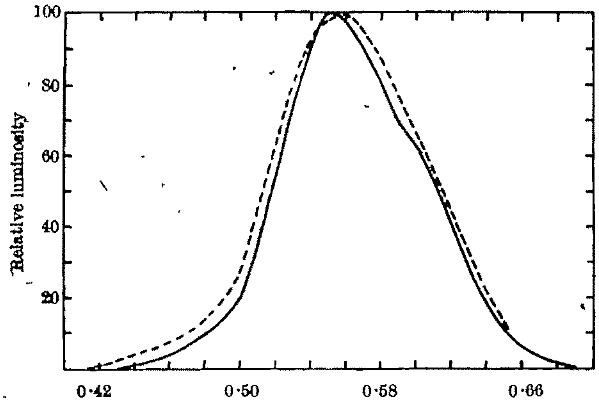

Fig. 2. LUMINOSITY CURVES FOR 20′ AND 2° FIELDS, CENTRALLY FIXATED.
Continuous curve, 20′ field. Broken line, 2° field.

stimuli. A mean value for the ratio L_R/L_B was obtained as 0·73/1·00. If the coefficients, r and b, at any wave-length λ are then multiplied by 0·73 and 1·00 respectively, the relative amounts of 0·65 μ and 0·46 μ, in luminosity units required to match λ, are obtained. The ordinate of the equal-energy luminosity curve at wave-length λ can then be divided into two parts, representing the amounts, in luminosity, of 0·65 μ and 0·46 μ required to match the amount of λ present in the equal-energy spectrum. Repetition of this calculation at intervals through the spectrum then yields the spectral mixture curves shown in Fig. 3.

Since these curves are expressed in terms of matching stimuli which produce all-positive mixture curves, and since, as reported below, 0·65 μ and 0·46 μ are located at points in the spectrum where the change of hue with wave-length effectively vanishes, there is some justification for assuming (though it is not proved) that 0·65 μ and 0·46 μ each stimulate only one of the two receptor units which must exist in the central fovea. If this is so, then the curves in Fig. 3 represent the spectral sensitivities of the two receptor systems responsible for colour perception at the fovea. It should be pointed out, however, that this argument rests on certain assumptions with regard to the nature of the receptors, and further work is necessary before a definite conclusion can be reached. Nevertheless, two features of the curves may be noted: (*a*) the 0·46 μ curve corr sponds quite closely to the 'green' curve given in mo of the derivatives of the fundamental response curv of the Young–Helmholtz theory (for a summary these curves see Walters[14]). This similarity was al reported by Konig[6]. (*b*) The 0·65 μ curve is irregul in shape, but reaches a maximum value at abo 0·60 μ. Because of this irregularity, the curve diffe from the fundamental red response curve as usuall derived; this deviation was again noted by Koni although he gave no indication of the nature of th difference. The maximum near 0·60 μ provides adde support for the existence, under some conditions, the peak in the luminosity curve in that region[1] support which is the more significant because it do not depend upon any very obvious peak in th luminosity curve from which the mixture curv were derived.

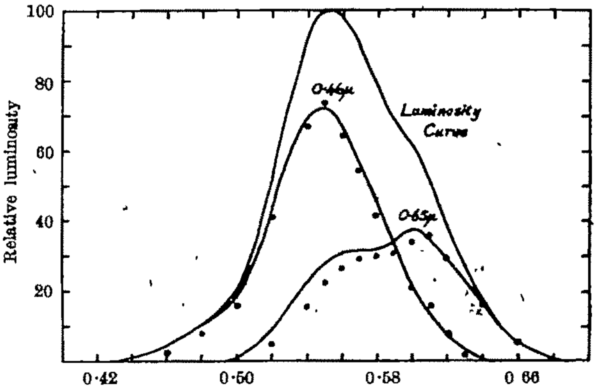

Fig. 3. LUMINOSITY AND SPECTRAL MIXTURE CURVES FOR 20′ FIELD, CENTRALLY FIXATED.
Continuous curves as determined by W.D.W. Circles, spectral mixture curves for E.N.W.

The hue discrimination curve (Fig. 4) was recorde by illuminating one half of the field with mon chromatic light of wave-length λ and the other ha by light of wave-length λ + Δ λ. Δ λ was increase until a difference in hue could just be detected whe the brightness of the two halves of the field wa equalized. The value of the just noticeable wave-length difference Δ λ was then plotted at the wave-length $\lambda + \frac{\Delta\lambda}{2}$ to give the observations recorded in Fig. 4. As will be seen from the individual observations shown in the diagram, the spread of the measurements was considerable. This was probably due to the difficulty in fixating the field correctly, and also to the inherent difficulty of observation with such a small field. The shape of the curve is very different from that for normal vision with a 2° field[15], but it does correspond to the probable discrimination of the tritanope[11], who appears to have reasonably good discrimination in the yellow part of the spectrum, but very poor discrimination in the blue-green. In the neighbourhood of 0·46 μ there is an effective discontinuity in the curve, since the change of hue with wave length falls to zero at this point. Observations in this region have little meaning, since if λ were set at, say, 0·44 μ, then on increasing the wave-length of the comparison field to λ + Δ λ, the quality of the light will tend to become different until λ + Δ λ reaches 0·46 μ, but beyond this point the qualities will tend to approach one another again. With λ at

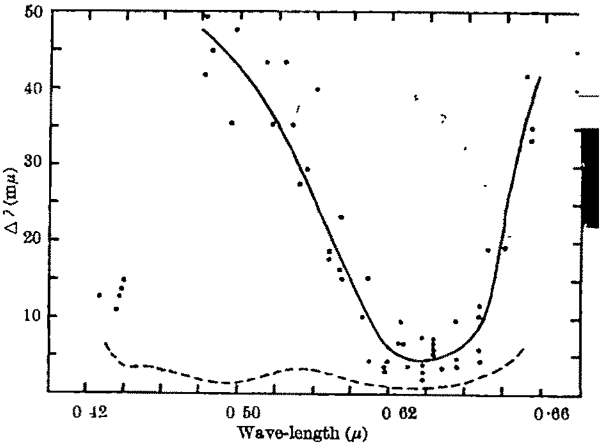

Fig. 4. HUE DISCRIMINATION CURVES.
Continuous curve, for 20′ field. Broken curve, for 2° field.

iorter wave-lengths, for example, $0{\cdot}42\,\mu$, a discriminable step could be observed before $0{\cdot}46\,\mu$ was eached, although the observation was difficult owing o the low intensity.

The results given here represent experimental data hich unequivocally confirm König's original statement that the central fovea is dichromatic and ritanopic. It is difficult to explain why his observations were received with such doubt for so many ears, unless the reason lay in the difficulty of locating he small test field on the fovea and maintaining it n that position for more than a very short time. Vith the test fields used in the present experiments, ny deviation from direct fixation immediately caused breakdown in the matches obtained; whether this vould have been true with still smaller fields it is mpossible to say without further experiment. Prof. I. Hartridge's observations and those of one of us E. N. W.) with painted test fields suggest that it nay not be so. With regard to Prof. Hartridge's onclusions[5] about the dichromatism of retinal areas ther than the central fovea, it is likely that colour natching experiments may confirm this provided the est field is of suitable size, yet we believe that the haracteristics of the central fovea differ significantly rom those of the retinal areas in its immediate neighbourhood. Experiments are in progress to nvestigate this question.

We wish to express our thanks for the continued upport of the Medical Research Council.

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ESTER WAX: A NEW EMBEDDING MEDIUM

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In view of the many disadvantages of paraffin wax as an embedding medium, a search was made among natural and synthetic fatty acid esters for a more suitable material. No single substance was found which had all the necessary requirements, but a mixture was finally produced using diethylene glycol distearate as the main ingredient. A complete account of this work will be published elsewhere.

A formula suitable for most types of tissue is as follows:

Diethylene glycol distearate	82 gm.
Ethyl cellulose, low viscosity	4 „
Stearin	5 „
Ricinoleic (octadecanediol) diacetate	9 „

The following are among the physical characters of this mixture:

Melting point	48° C.
Section range	4–20 μ at a room temperature of 66° F.
Ribbon range	4–15 μ at a room temperature of 66° F.
Compression after flattening	7·6 per cent at 10 μ.

The diethylene glycol distearate should be heated and filtered before the mixture is made. It should be kept in a molten condition in an oven for two days to allow any free diethylene glycol which it may contain to settle down. The ester may then be decanted.

Ricinoleic diacetate is unobtainable in Great Britain and has to be made from ricinoleic alcohol (octadecanediol) and acetic anhydride. Should these materials be difficult to obtain, castor oil may be used instead.

To make up the mixture put the diacetate into a porcelain pot and add about 15 gm. of the distearate. Heat until the distearate is melted and then add the cellulose. Heat until this is dissolved and then add the rest of the distearate and the stearin. The cellulose dissolves only at a high temperature (approximately 100° C.) and solution should take place with the minimum possible of the two other solids present.

Ester wax is soluble in most alcohols, ethers, esters, ketones, hydrocarbons, chlorinated hydrocarbons and natural oils. The following have been found suitable as clearing agents as well as solvents:

Dioxan.
Ethylene glycol mono ethyl ether ('Cellosolve')
Ethylene glycol mono butyl ether.
Diethylene glycol mono butyl ether.
Cedarwood oil.

As with paraffin wax, a pre-embedding bath of solvent and ester wax is recommended before placing the specimen in ester wax. The time which each specimen requires is the same as when using paraffin wax.

L-pieces are recommended for block-making, and as the block is cooling with the specimen in it the hollow which is produced in the centre due to shrinkage should be filled in with drops of molten ester wax. Rapid cooling of the block by placing it in, but not submerged in, cold water, produces a slightly better block than one cooled at room temperature.

Ester wax is harder than paraffin wax, and in trimming, thinner cuts should be made to prevent chipping. A one-sided razor blade is most suitable.

Sections should be cut at a slower speed than for paraffin wax sections. If cut too slowly poor ribboning results; if cut too fast the sections will crinkle considerably. The crinkles will go when the sections are flattened, but even then the fewer the better. Experience soon indicates the correct speed.

The most important property of ester wax is that of 'ribbon staining'. Instead of flattening on water, as with paraffin wax, ester wax sections may be flattened on stain solutions which easily penetrate the wax and stain the sections. The stain is then drained off, the slide irrigated with water to remove the excess stain, and the sections may then be dried in an oven. To make this clearer the steps are as follows:

1. Flood an albumened slide with methylene blue solution; Loeffler's formula full strength or diluted up to 1 in 10,000. A weak solution is preferable because of the later removal of excess stain which dries on the slide.

2. Lay the ribbon on the stain solution and flatten in by placing the slide on a warm plate or on the surface of warm water at about 40° C. until the wrinkles in the wax disappear.

3. Drain away the excess staining solution. Lower the slide below the surface of distilled water in a petri dish. Gently agitate the slide until it is quite free from methylene blue, and then raise it out of the petri dish with the sections on it. Drain away most but not all of the water. Place the slide in an oven at about 40° C. until dry. *It is important to dry at this temperature or slightly higher or the sections will be wrinkled.* After one hour or even less, the sections will be dry enough for dissolving the wax, differentiating, and counter-staining.

The sections or ribbons may be flattened on water if preferred and treated as paraffin ribbons.

Removal of wax may be done in xylol, which will dissolve the wax without dissolving the methylene blue. It does not dissolve the ethyl cellulose very quickly, however, and a mixed solvent of xylol, ethylene glycol mono ethyl ether ('Cellosolve'), and ethyl acetate is recommended. Should the sections have been stained progressively to a point at which no further extraction of methylene blue is necessary the following mixture is suitable:

'Cellosolve'	10 per cent
Ethyl acetate . ..	45 ,, ,,
Xylol	45 ,, ,,

The wax will be removed in about five minutes and the sections may then be transferred to pure xylol, and mounted with balsam in the usual way.

Generally sections are overstained and differentiated in a mixture similar to the above but with a greater proportion of the stain solvent--'Cellosolve'. In some cases pure 'Cellosolve' alone may be needed to remove the methylene blue from the tissues. Extraction is stopped by placing the slide in the 10 per cent 'Cellosolve' mixture.

Sections can be counter-stained in erythrosin or eosin dissolved to saturation in the following:

'Cellosolve'	20 c.c.
Ethyl acetate	40 ,,
Xylol	40 ,,

This process takes place simultaneously with differentiation of methylene blue or other stain and with the removal of wax. Sections may first of all have part of the wax removed in the 10 per cent 'Cellosolve' mixture, or in pure 'Cellosolve' if heavily overstained with methylene blue, and then may be transferred to the counter-stain. In this the tissue will continue to lose a trace of methylene blue and any remaining wax will be dissolved. When staining is satisfactory the slide is placed in a lower 'Cellosolve' mixture (10 per cent or less). This will prevent any further extraction of methylene blue and will also slightly intensify the erythrosin staining. Finally the slide is transferred to pure xylol, and mounted in balsam.

Clean differentiation of both stains and perfect control throughout all operations are the principal advantages of the method. Other stains may be employed, but methylene blue and erythrosin have, up to the present, been the most satisfactory.

To prevent the methylene blue fading the sections should be mounted in 'Sira' (Stafford Allen & Co., London) and not baked. Such preparations will last for years.

The general outline of the method has been given above. In practice the following solutions are found to cover any combination of wax removal, differentiation of the first stain and application of the counter-stain which may be required:

	1	2	3	4	5	6	7	
'Cellosolve' ..	–	–	5	10	20	40	80	1
E. acetate ..	–	–	47	45	40	30	10	
Xylol .	100	100	48	45	40	30	10	

No. 5 should have erythrosin to saturation.

The following reagents are not usually supplied l the general chemical supply houses, but may obtained from the sources given: diethylene glyc distearate (Messrs. A. Boake Roberts, "Ellerslie Buckhurst Hill, Essex); ricinoleic alcohol (oct decanediol) (Imperial Chemical Industries, Stockto on-Tees); ethyl cellulose, low viscosity (Messrs. J. M Steel, Kern House, Kingsway, London).

THE BRITISH COUNCIL

THE last annual report of the British Counc which covered the year ending March 31, 194 (see *Nature*, 155, 58; 1945), well indicated the in portance of the work of the Council, not only in th war effort but also for the establishment of cultur relations in times of peace. The Council's work i making British contributions to science better know abroad and promoting contacts between British me of science and those of other countries, particularl since the establishment of its Science Departmen four years ago, has become so important that th tenth anniversary of the inauguration of the Britis Council in July 1935 should not be passed unmarke by scientific workers.

The present moment is therefore appropriate t recognize the work of its Science Committee and it Pure Science Panel, of both of which Sir Henry Dale i chairman, as well as its Panels for Medicine, Engineer ing and Agriculture. One of the earliest activities o the department was the publication of a four-pag illustrated newsletter, *Monthly Science News*, in whic accounts of research are presented in a form intelligibl to non-scientific readers. Translated into French, Spanish, Portuguese and Arabic and reprinted in seven different countries, this has now a monthly circulation of 65,000. Compiled in collaboration with learned societies, professional bodies and the scientific and technical Press, *Science Comment*, a monthly compilation of abstracts and reviews started in 1943, is circulated to universities, libraries, etc., and scientific workers overseas to keep them informed of important publications in the scientific and technical field. A section has recently been added dealing with scientific films. The publication is used by booksellers as a valuable indication of British scientific publications likely to be in demand and in introducing technical and scientific periodicals to a wider overseas public.

Much has been done by the Council to enable British men of science to keep in touch with fellow-workers in other countries in the same field; the exchange of papers and specimens has been maintained and an ever-increasing number of requests for scientific information reaches the Council. Much material for *Nature* has been transmitted by the British Council. To facilitate the work in France, a scientific adviser has been appointed to the recently opened office in Paris. Scholarships are awarded by the Council to enable promising students to visit the United Kingdom and learn of British methods; since 1939 more than six hundred students have been brought from the Dominions, Colonies and many other countries.

During the War, some three hundred short-leave courses have been arranged at universities, technical lleges and other institutions in Britain for about n thousand members of the Dominions and U.S. orces, and under the Professional Contacts Scheme large number of scientific and professional men in the ominion and Allied Forces have been put into conct with their opposite numbers in Great Britain d with appropriate professional bodies. The cretary of the Engineering Panel, Prof. S. J. Davies, so acts as consultant to the Council; his section eks to promote a better knowledge of the status d the achievements of British engineering and of the ngineering qualifications granted by British univerties and the major British engineering institutions.

The Medical Department's *British Medical Bulletin* now in its third year, with editions in English, ench, Spanish, Portuguese and Turkish, and its eputation is steadily being extended now that a imited number of copies are available by subcription in Britain; a similar arrangement is being eveloped elsewhere, supplementing the previous striction to medical editors, teachers, investigators nd libraries. On the suggestion of a Swedish prossor of medicine, the English edition is reprinted in tockholm. The present edition exceeds 12,500 copies, nd more than three hundred foreign medical periodials are regularly received in exchange. Requests for copies of papers, bibliographies and general informaon on medical subjects now form an important part f the work, and this and other services have led to many requests for small supplies of new drugs for esearch purposes and for new or improved types of medical instruments and apparatus of British manuacture. The Department also acts as an agent for he supply to foreign laboratories of standard bacterial cultures, sera, etc., and has made a start on a programme of medical films, with commentaries in everal languages, intended primarily for overseas medical audiences.

The chairman of the Medical Panel is Sir Edward Mellanby; of the Engineering Panel, Sir William larke; and of the Agricultural Panel, Dr. J. A. Scott-Watson. Mr. J. G. Crowther is secretary of the Science Committee and director of the Department.

Even without taking account of the general educational work of the Council, there can be no mistaking the value of the contribution of scientific collaboration which the British Council has unobtrusively made during the last ten, and especially the last four, years.

SOME BRITISH WORK ON NUTRITION

NUTRITION is the theme of vol. 2, Nos. 10 and 11 of the *British Medical Bulletin*. The issue opens with an article on nutritional science in medicine by Sir Edward Mellanby. Sir Edward pleads for an international agreement on the optimum composition of bread and other cereal foods which form such a large proportion of the normal diet. The Health Section of the League of Nations has prepared the way for this kind of agreement by working out the international standardization of vitamins and by setting up standards of nutrition in terms of common foods. Discussing bread, Sir Edward says that British men of science consider that it should be made of flour containing as much of the wheat grain as can be physiologically absorbed, that is to say, the whole grain except the outer coarse bran; some North American workers, on the other hand, favour the old type of low-extraction, and white flour with the addition of vitamins known to be present in the wheat grain. The health of the consumer, said Sir Edward, and not the milling or other interests concerned, should control the composition of bread.

This question was raised during a discussion of the nutritional value of bread held by the Nutrition Society last February (see *Brit. Med. J.*, 379, March 17, 1945). The matter was also debated in the House of Lords (see *Lancet*, 320, March 10, 1945; *Brit. Med. J.*, 393, March 17, 1945). During this debate Lord Horder and others strongly criticized the Government's decision last January to use for the national loaf flour of 80 per cent extraction instead of the flour of 85 per cent extraction adopted in 1942. Both the medical journals vigorously discussed this national question in leading articles.

If the composition of bread is vitally important as a basic nutritional factor in health and disease, the importance of other factors is revealed by various expert articles in the issue of the *British Medical Bulletin* under notice. These articles discuss protein metabolism, minerals, nutritional factors in dental disease, the physical, chemical and microbiological determination of vitamins and water metabolism. Dr. S. S. Zilva's article on vitamin C criticizes much of the recent literature about this vitamin. He concludes that so far there is no convincing evidence that vitamin C has an influence on any condition other than scurvy. "It is true," he says, "that synthetic *l*-ascorbic acid has its advantages in certain cases of human disease, but this is by no means balanced by the gross and unwarranted abuse of the compound for nutritional purposes." Dr. Magnus Pyke, of the Ministry of Food, records interesting facts about the problems of British war-time food rationing. The review of selected papers on nutrition which follows the main articles provides a valuable compendium of the most important literature.

This issue of the *British Medical Bulletin* could advantageously be read together with reports (*Brit. Med. J.*, 127, Jan. 27, 1945; *The Lancet*, 829, Dec. 30, 1944) of the Nutrition Society's meeting on the nutritional role of the microflora of the intestines, to some aspects of which the work of the Unit of Animal Physiology working at Cambridge has made valuable contributions (see R. A. McAnnally and R. T. Phillipson, *Biol. Rev.*, 19, 41; 1944). The facts given at this meeting of the Nutrition Society about the biosynthesis of certain vitamins in the bowel will have their influence upon medical practice. *The Lancet* (*loc. cit.*) reviews, for example, the evidence for the view that the use of sulphonamides may sterilize away the beneficent bacteria which synthesize essential vitamins. The conclusion that we shall have to regard the intestinal flora as part of the individual's constitution is yet another of many recent instances of that consideration of the whole organism plus its environment, which is a fundamental concept of modern biology. If, moreover, it is true that certain vitamins may be synthesized in the intestine, it may be necessary, as the *British Medical Journal* (191, Feb. 10, 1945) warns us, to reconsider work done on these vitamins with man as the experimental animal. Certainly the work here discussed by this journal suggests that further investigation is required of the view that diets very deficient in vitamin B may quickly cause physical and mental deterioration.

G. LAPAGE.

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned

Junior Engineering Assistant—The Waterworks Engineer and Manager, Civic Centre, Southampton (August 3).

Assistant Power Station Chemist—The Borough Electrical Engineer, 40–41 Lune Street, Preston, endorsed 'Assistant Chemist' (August 4).

Assistant Agricultural Organizer—The Principal, Agricultural Institute and Experimental Station, Kirton, Boston, Lincs. (August 4).

Head of the Mathematics and Physics Department of the South-East Essex Technical College and School of Art, Longbridge Road, Dagenham—The Chief Education Officer, County Offices, Chelmsford (August 4).

Assistant Lecturer in Physics, and a Lecturer in Metallurgy, in the Bradford Technical College—The Director of Education, Town Hall, Bradford (August 4)

Lecturers (2) in Chemistry—The Secretary, The University, Birmingham, 3 (August 8)

District Mechanical Engineers by the Iraqi State Railways—The Ministry of Labour and National Service, Appointments Department A 9, Room 070, York House, Kingsway, London, W C.2, quoting Ref. No. C.2378.A (August 10).

Engineer and General Manager—The Town Clerk, Town Hall, Upper Street, Islington, London, N.1, endorsed 'Engineer and General Manager' (August 11).

Corporation Chemist and City Analyst to the Corporation of Glasgow—The Town Clerk, City Chambers, Glasgow, endorsed 'Corporation Chemist and City Analyst' (August 11)

Assistant Lecturer in Mathematics at the Bradford Technical College—The Director of Education, Town Hall, Bradford (August 11).

Agricultural Assistant, and an Assistant Dairying Instructress, at the Somerset Farm Institute, Cannington—The Chief Education Officer, County Hall, Taunton (August 11).

Assistant (man or woman) in the Department of Geography—The Secretary, Bedford College for Women, Regent's Park, London, N.W.1 (August 13)

Lecturers in Chemistry, and a Lecturer in Physics and Mathematics—The Principal, Sir John Cass Technical Institute, Jewry Street, London, E.C 3 (August 15).

Secretary—The Director, School of Oriental and African Studies, University of London, London, W.C.1 (August 15).

Assistant Lecturer in the Department of Mathematics, and an Assistant Lecturer (temporary) in the Department of Physics—The Registrar, University College, Hull (August 18).

Assistant Registrar—The Registrar, University College, Hull (August 18).

Professor of Chemistry—The Secretary, Royal Technical College, Glasgow (August 31).

Lecturer in the Department of Electrical Engineering—The Registrar, The University, Sheffield (August 31)

Lecturer in Applied Mathematics, and an Assistant Lecturer in Applied Mathematics—The Acting Registrar, The University, Leeds, 2 (September 1).

Principal—The Secretary to the Board of Governors, College of Aeronautics, 14 Belgrave Square, London, S.W.1 (September 8).

Lecturer in Geography—The Secretary and Registrar, The University, Bristol (September 10).

Senior Assistant to the Librarian—The Secretary and Treasurer, University College, Dundee (September 30).

Chair of Psychiatry tenable at the Maudsley Hospital—The Academic Registrar, University of London, Richmond College, Richmond, Surrey (October 1).

Principal—The Secretary, King's College of Household and Social Science, c/o University College, Leicester.

Honours Graduates interested in problems of Agricultural and Biological Research—The Secretary, Rothamsted Experimental Station, Harpenden, Herts.

Practical Engineer to break down Machining Operations from Drawings—The Ministry of Labour and National Service, Appointments Office, 153 Barras Bridge, Newcastle-upon-Tyne, 2 (quoting Ref. No. 211.M).

Teacher of Mathematics and/or Drawing in the Engineering Department of the Burton-upon-Trent Technical Institute and Junior Technical School—The Secretary and Director of Education, Education Offices, Guild Street, Burton-upon-Trent (endorsed 'T').

Lecturer (temporary full-time) in Physiology and General Science at the Chelsea College of Physical Education (temporarily evacuated to Borth, Aberystwyth)—The Principal, Chelsea Polytechnic, Manresa Road, London, S.W.3.

Lecturer (full-time, Graduate) in Electrical Engineering for Electrical Engineering subjects to Higher National Certificate standard, a Lecturer (full-time, Graduate) in Mechanical Engineering for Mechanical Engineering subjects to Higher National Certificate standard, and part-time Lecturers for Evening Classes in Electrical, Mechanical and Production Engineering, Welding, Industrial Administration, Foremanship, Time and Motion Study, Production Control and Industrial Psychology, in the Engineering Department; and a part-time Lecturer in Physics up to General Degree standard, in the Science Department—The Principal, Kingston Technical College, Kingston, Surrey.

REPORTS and other PUBLICATIO

(not included in the monthly Books Supplement)

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NATURE

No. 3953 SATURDAY, AUGUST 4, 1945 Vol. 156

CONTENTS

Page
onditions for the Promotion of Research . . . 125
e Rural Pursuits of President Jefferson. By Dr. E. J. Salisbury, C.B.E., F.R.S. 128
nthropology of Portuguese Timor. By Prof. A. R. Radcliffe-Brown 129
edicine and Mankind. By A. S. M. . . . 129
Plan for Research in the United States . . 130
ructure, Degeneration and Repair of Nerve Fibres. By J. Z. Young, F.R.S. 132
bituaries:
  Dr. P. Pelseneer. By R. Winckworth . . 136
  Prof. E. Barclay-Smith. By Prof. A. J. E. Cave . 136
ews and Views 137
etters to the Editors:
  Penetration of Fast Nucleons into Heavy Atomic Nuclei.—Prof. L. Rosenfeld 141
  A New Interference Effect.—F. K. Bauchwitz and D. Shoenberg 142
  Scaliness of Wool Fibres.—J. Menkart and Prof. J. B. Speakman 143
  Mechanism of the Feulgen Reaction.—J. G. Carr 143
  Viridin : a Highly Fungistatic Substance Produced by *Trichoderma viride*.—Dr. P. W. Brian and J. C. McGowan 144
  Abnormal Lignification in the Wood of some Apple Trees.—Dr. A. Beryl Beakbane and Dr. Eleanor C. Thompson 145
  Pressure Units.—E. Denne 146
  The 'Green Flash' at Sunset with a near 'Horizon'.—D. R. Barber 146
Viscosity of Liquids and Colloidal Solutions. By Dr. G. W. Scott Blair 147
Health Research in Industry. By Dr. G. Lapage . 148
Use of Trees and Shrubs as Food for Cattle . . 151
Electromechanical Analogies 151

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CONDITIONS FOR THE PROMOTION OF RESEARCH

THE report entitled "Science: the Endless Frontier" which Dr. Vannevar Bush has presented to the President of the United States and which, it is understood, will be the subject of important legislation in the near future, is of profound interest to scientific workers in Great Britain as well as to those in the United States. The report, a summary of which appears on p. 130 of this issue, owes its inspiration to a request of President Roosevelt last November, and a sentence from his letter is fittingly quoted as striking the keynote of the report: "New frontiers of the mind are before us, and if they are pioneered with the same vision, boldness and drive with which we have waged this war, we can create a fuller and more fruitful employment and a fuller and more fruitful life". The proposals of the report represent in fact a definite attempt to mobilize for peaceful purposes the scientific effort which has proved so effective in war, and to secure that both the range and resources of scientific research are adequate, and the necessary personnel available over a long-term and not merely a short-term period.

Recommendations for the achievement of such objectives could not but fail to attract attention generally, but the most cursory reading of the report reveals how much ground is covered which is common with discussions which have been proceeding in Great Britain during the last few years on the organization and endowment of research. Many of the arguments which Dr. Bush and the distinguished committees on which he called for advice adduce in support of the recommendations of this report are equally valid in regard to the expansion and encouragement of research in Britain, and it is clear from the reports of the four committees that British experience has been in their minds in formulating their findings. The Medical Advisory Committee under Dr. W. T. Palmer, for example, clearly arrived at its recommendation for the establishment of a National Foundation for Medical Research as an independent Federal agency after reviewing the place both of the Medical Research Council and of the University Grants Committee in fostering medical research in Britain.

While the report is undoubtedly inspired by President Roosevelt, much of the ground has clearly been prepared by the surveys previously conducted by the Science Committee of the National Resources Committee on the relation of the Federal Government to research, and by the National Research Council for the National Resources Board on industrial research. Indeed, the findings and somewhat tentative recommendations of the former report published in Washington in 1938 under the title "Research—A National Resource. 1. Relation of the Federal Government to Research" re-appear essentially in those of Dr. Bowman's Committee on Science and the Public Welfare; they have obviously prepared the way for the recommendations for the creation of a National Research Foundation and for strengthening and expanding after the War the research carried on directly by the Federal Government. Dr. Bush's report, however, differs somewhat in scope: the questions arising out of research in social sciences and the humanities are excluded; but on the other hand, the question of medical research is surveyed as already indicated and the place of the universities and colleges is considered, not merely as centres of research but also from the point of view of supplying the trained workers required for an adequate programme of scientific research.

Broadly speaking, it may be said that the strategy of research advocated in this report is to provide the universities and colleges and research institutes with adequate resources for fundamental research, to ensure that the fullest freedom of inquiry is adequately safeguarded, to provide scholarships and fellowships sufficient to ensure the supply of scientific talent required both in fundamental research and in Government service and industry. It is also proposed to extend the organization of research under direct Government control on lines indicated by experience with the Office of Scientific Research and Development to secure support for research in such fields of acute public interest as military problems, agriculture, housing, public health and medicine, which is meagre or intermittent because of lack of interest from private sources or because the demands for capital investment are too high for private provision. There is in fact no suggestion in the report for planning fundamental research. The creation of a single over-all agency for the discharge of Government responsibilities in these fields is intended rather to ensure that no important fields of applied research are neglected, that adequate supplies of trained workers are continuously recruited and that fundamental research is adequately endowed. If those conditions are fulfilled and the free exchange of scientific knowledge fostered, both within and across the national frontier, it is held that there is no risk that the continuous advance of fundamental research will fail to provide the new knowledge upon which depend progress in the war against disease, and the attainment of a higher standard of living.

The emphasis thus placed on free inquiry and on the fullest possible interchange of scientific knowledge is one of the most striking features of Dr. Bush's report. That emphasis is of course to be found in many of the reports on scientific and industrial research which have appeared in Great Britain during recent years; but no other report has yet emphasized so clearly and emphatically the necessity for lifting the existing restrictions on the publication of new scientific knowledge accumulated during the War. Although the report of Dr. Irwin Stewart's Committee on the publication of scientific information is the shortest of the four appended to Dr. Bush's report, it is not the least important, and it has strong claims on the immediate attention of all scientific workers.

During the War, we have been living to a considerable extent on our scientific capital, for men of science who would normally be extending the frontiers of knowledge have instead devoted their efforts to the application of scientific knowledge to the devel ment of new and better equipment, processes materials for war purposes. Many such new scient discoveries as have been made are now classified confidential or secret, and war-time restrictions h prevented the wide dissemination of the kind information upon which science, education a industry normally build. Scientific workers enga on war projects have acquired new knowledge specific fields, but they have not been given acc to similar acquisitions by their colleagues in ot fields.

One of the first tasks which Dr. Bush consid should be undertaken is that of extending the bro base of scientific knowledge available to all scienti workers and lifting, as soon as military conditi permit, even the limited restrictions on publicati of new knowledge in the fields of medical resear which the Secretaries of War and the Navy impos during the first year of the existence of the Office Scientific Research and Development. This, mo over, is not a matter that concerns the United Stat alone. Dr. Stewart's committee points out that so of the information which should be released is p sessed jointly by the United States and its Alli and release in that country should be co-ordinat with release in other countries. The establishme within the National Academy of Sciences of a boa to control the release and prompt publication certain scientific information has previously bee proposed, and such a central agency affords the be means of handling the international aspect also wit the minimum of delay and friction.

This is not the only indication in the report of th importance which is attached by Dr. Bush and th committees he consulted to free and full publicatio as a stimulus to scientific research. Dr. Stewart' Committee urges specifically that, besides adopting liberal policy in permitting the release of scientifi information as soon as it is apparent that it canno be turned against us in the present War, the proposed board, and also Government administrators should encourage investigators to publish the result of their work in fields thus released. Financial suppor for such publication is advocated not only by thi Committee but also by Dr. Bowman's Committee i its recommendations for Government support and sponsorship of international scientific congresses and the like, and for exploring the possibilities of scientific attachés in improving scientific communication. More particularly, after glancing at the question of library aids, Dr. Bowman's Committee refers to the need for Government assistance in dealing with the temporary problem of filling the serious gaps in collections of important European scientific periodicals in American libraries caused by the War, and to the probability that Government assistance will also be required in regard to the abstracting of scientific and technical literature.

Already in December 1940, when the Science Committee of the National Resources Planning Board issued its report on industrial research, the support by scientific societies of the publication of abstracts of the technical literature was becoming increasingly urdensome and inadequate in several branches of cience in face of the rapidly expanding amount of echnical literature published. That report suggested hat an excellent means of Government contribution o industrial research would be proper provision for systematic and complete publication of abstracts of scientific and technical literature. The Bowman Committee makes no fresh recommendations on this matter, but its reference to the existence of this nd of translating and bibliographic problems indicates the importance which American opinion attaches to such matters, and to the thoroughness with which in the post-war years tactical means for the efficient spread and effective utilization of scientific knowledge are likely to be explored and developed in the United States.

As has been indicated, the full success of American policy in this field cannot be achieved in isolation, and that alone would be sufficient reason for singling out this feature of the report for special mention at the moment. However, apart altogether from this question of the removal of war-time restrictions on publication, industry itself in the United States has generally been more disposed to encourage publication than industry in Great Britain. A more enlightened and generous attitude in this respect was strongly urged in the report on industry and research issued in October 1943 by the Industrial Research Committee of the Federation of British Industries, and has been powerfully supported on other occasions by Lord McGowan, Dr. P. Dunsheath and Mr. S. Courtauld. There can be only the warmest welcome for the emphasis on the free and unimpeded exchange of scientific information by publication and in other ways which characterizes this report.

If American strategy in the matter of research, as indicated by this report, appears to be simple, there can be no mistaking the thoroughness with which the correct tactics are being worked out; and the proposals of the report deserve close study by all those concerned with the post-war organization of scientific and industrial research in Great Britain. The report of Mr. H. A. Moe's Committee on the discovery and development of scientific talent, with its long-term plans aimed at ensuring an adequate future supply of engineers and scientific workers by discovering and developing scientific talent in American youth, and its immediate plans to make up in part the deficits resulting from the War, should not be disregarded by those concerned with demobilization and retraining, or with post-war plans in Britain for the expansion and development of the universities and technical colleges. When all allowance is made for the differences in economic and social conditions between the United States and Britain, the factors which determine whether or not a scientific career will attract and hold a sufficient proportion of the ablest minds of each generation are largely independent of geography, and measures or tactics which succeed in one country are likely to be effective elsewhere.

Broadly speaking, the proposals go further towards providing the Government of the United States with a fact-finding and policy-making instrument for science than anything yet set up elsewhere. The suggested National Research Foundation has much wider powers and functions than the central research board proposed last year by the London Chamber of Commerce in its report on "Scientific Industrial Research", and still more than those of the scientific advisers to the Ministry of Production. As a means of co-ordinating policy and developing and applying tactics, it should be a far more effective instrument than the limited powers which in Britain reside in the Lord President of the Privy Council, whether through his responsibilities in regard to the Department of Scientific and Industrial Research, the Medical Research Council, the Agricultural Research Council or as president of the Scientific Advisory Committee of the War Cabinet. Moreover, there is in Britain at present no means of co-ordinating scientific research on matters appertaining to defence as is provided by the Division of National Defence, and in its absence not only is there risk that long-range research on such matters may not be prosecuted adequately, but in particular that new weapons or forms of warfare which are not clearly the business of any one of the three Services may be neglected. Likewise nothing in the present structure in Britain remotely fulfils the function of the proposed Division of Publications and Scientific Collaboration, despite the work that has already been done by the British Commonwealth Science Committee set up by the Royal Society. Similarly, while some of the functions proposed for the Division of Scientific Personnel and Education might be discharged in Britain by the Appointments Department of the Ministry of Labour if effect were given to the recommendations of Lord Hankey's Committee on Higher Appointments, there is no single body with quite such wide powers or which could exercise the same influence in seeing that no important fields of knowledge are left uncultivated.

While, therefore, little in the proposals or the reports which Dr. Bush has transmitted to the President of the United States has not, so far as relevant to British conditions, found expression in the debate on scientific and industrial research which has proceeded here during the last two years or so, there is considerable difference in emphasis. Moreover, the proposals outlined tend to bring out more clearly some of the weaknesses in the research structure of Great Britain and to indicate measures required, even if those to be applied here are not necessarily those best suited to American conditions. In some respects British organization is clearly ahead of American practice at present, at least so far as Government organization itself is concerned; but the publication of this report, apart from the introduction of any legislation to implement its proposals, should give a marked stimulus everywhere to both thought and action in a field where they are much needed. Not merely is it desirable that we should be ready to co-operate appropriately, where joint action is required, in the removal of restrictions and the fostering of the exchange of information and of personnel. In the field of defence the United Nations Organization will also make it necessary to provide adequate means of co-operation in regard to research on new methods and weapons of warfare and national defence. The war on disease is supremely a task for international co-operation in research, both for treatment and preventive measures. Nor can we neglect to take account of what the United States and other industrial countries are doing to encourage research in industry, if we are to rectify the neglect with which some fields of British industry have been charged in the past, and to attain the industrial efficiency essential for the achievement of our plans and hopes for social security, for full employment and a higher standard of living.

THE RURAL PURSUITS OF PRESIDENT JEFFERSON

Thomas Jefferson's Garden Book, 1766–1824, with Relevant Extracts from his other Writings

Annotated by Prof. Edwin Morris Betts. (Memoirs of the American Philosophical Society, Vol. 22.) Pp. xv+704+36 plates. (Philadelphia: American Philosophical Society, 1944.) 5 dollars.

To most gardeners, I suppose, the name Jefferson suggests that most delicious of dessert plums that was raised by Judge Buel of Albany, New York, the year before Jefferson died. This is a fitting memorial to one who in addition to his activities as ambassador, governor, Secretary of State and President, was both an accomplished naturalist and devoted gardener. Barton, the botanist, who named the genus *Jeffersonia* in Thomas Jefferson's honour, stated "In the various departments of science, but especially in Botany and Zoology, the information of this gentleman is equalled by few persons in the United States".

The "Garden Book", which is the subject of the work under review, begins with an entry for March 30, 1766, a record of the flowering of the purple hyacinth, and ends with the year 1823, but during those fifty-seven years the entries vary greatly in number and extent. During Jefferson's considerable absences abroad no entries occur, and in the total the printed transcriptions of the actual diary occupy only about one hundred of the seven hundred of the present work. The rest of the text is made up of extracts from Jefferson's correspondence, garden entries from other of Jefferson's memoranda and numerous notes. The whole comprises an interesting commentary on the gardening and farming of this period and reflects the personality of an observing and exact mind.

Perhaps the most unusual feature, remembering that the garden book was compiled considerably more than a century ago, is the quantitative character of so many of Thomas Jefferson's notes. Thus he tells us that 2,500 of his early peas filled a pint measure. It required one hundred of his strawberries to fill half a pint, whereas to-day less than twenty would probably be required to occupy the same volume. Again, we read that it took Julius Shard three minutes to fill a two-wheeled barrow and a minute and a half to take it thirty yards. In the same manner he records the amount of water required for mortar and the quantity of vinegar yielded by his grapes. His calendar of the flowering times and the intervals between planting and maturity are similar expressions of a precise mind that was concerned with the efficiency of the mould board of a plough at one period and at another was concerne with the average length of the stride of a horse.

It is obvious from a perusal of these pages th Jefferson had a great love of trees and indeed h wrote that "planting trees has always been m passion inasmuch that I rarely planted a flower my life". Nevertheless, he obviously had an eye f a good herbaceous flower, and the list of plants whic he bought from James Lee of Hammersmith whe he visited England in 1786 included thre specimens of that exquisitely beautiful lily *Liliu canadense*.

Although he was familiar with the renowned garden near Paris, it was the English school of garden desig that aroused his greatest enthusiasm. After his retur from England he wrote "the gardening in that countr is the article in which it surpasses all the earth".

But if gardening was to this distinguished man o affairs his chief hobby, it was equally true that farming was one of his prime occupations. He clearl recognized what is too often forgotten, that horticulture and agriculture are branches of a commo stock that require for their successful developmen to be nourished from diverse fields of knowledge. O agriculture he wrote, "it is a science of the very firs order and counts among its handmaids the mos respectable sciences, such as Chemistry, Natura Philosophy, Mechanics, Mathematics generally, Natural History, Botany".

On his own farm, which covered an area of five thousand acres, more than eleven hundred acres were cultivated and he adopted a seven years rotation with two years of red clover, then crops of vetch and buckwheat, followed by wheat with folded sheep on turnips in the autumn, maize and potatoes, rye and clover. Jefferson evidently believed that the atmosphere was responsible for the restoration of soil fertility, and held that the advantage of manuring is that it will do more in one than the atmosphere would require several years to do. It was his farming activities that led him to devise a mould board that reduced the resistance to ploughing, to experiment with the germination of clover seed on moistened cotton and to determine the value of sowing devices in terms of the amount of seed required which showed that two-thirds of that sown by hand was wasted.

His attempts to introduce rice and olives into South Carolina were but isolated instances, of economic species, among the many endeavours which Jefferson made, often with success, to add to the range of exotic species grown in America.

When we add that he was a pioneer in the development of contour ploughing in the New World and recognized its great value in relation to erosion, it will be obvious that his activities in the rural sciences had a marked influence on their development beyond the limits of his own State. If the pages of this book are something of a patchwork in which the constituent fabrics are of diverse texture and significance, it is equally true that they epitomize the changing fashions and developments of half a century and the colourful occupations of a lifetime. The preparation of the work was made possible by the Penrose Fund of the American Philosophical Society, but it is to the labours of Prof. Edwin Betts that we owe the annotations without which the volume would have lost a great deal of its value, both as shedding light on the preoccupations of a versatile mind and on the horticulture and agriculture of the period.

E. J. SALISBURY.

ANTHROPOLOGY OF PORTUGUESE TIMOR

Timor Português

ontribuições para o seu estudo antropológico. Por Prof. A. A. Mendes Corrêa. (República Portuguesa, Ministério das Colónias: Memórias, Série Antroológica e Etnológica, 1.) Pp. 240+53 plates. Lisboa: Imprensa Nacional, 1944.)

PROF. MENDES CORRÊA gives us an ethnological account of a region about which not very much is known—the Portuguese part of the island of Timor. The greater part of the book is devoted to a study of the racial characteristics of the Timorese, based on unpublished anthropological investigations of Fonseca Cardoso, on a study of natives of Timor brought to the Portuguese Colonial Exhibitions of 1934 and 1940 and on a collection of several hundreds of photographs by a former governor of the colony, Alvaro de Fontoura.

Several writers on Timor have commented on the diversity of physical types among the inhabitants. Prof. Mendes Corrêa makes a classification into four major types which he calls Proto-Malay, Deutero-Malay, Melanesoid and Vedda-Australoid. Except in one region (the Bunak) he finds the Proto-Malay type more or less predominant. He identifies this type with the "Indonesian" type of Deniker.

The author examined the proportions of these four types in different linguistic groups. Our information about the languages of Portuguese Timor was until recently exceedingly scanty and unsatisfactory, and Prof. Mendes Corrêa has not been able to make use of the recent study of this subject by Capell[1]. This study has shown the existence of a number of languages that are quite definitely not Indonesian and not Austronesian (Malayo-Polynesian), but resemble in certain characteristics what are called the Papuan languages. He regards them as "pre-Indonesian". Bunak, mentioned above, is one of them. He also finds that the Indonesian languages of Timor fall into two distinct groups, and those of the eastern part of the island (the Portuguese portion) apparently have closer affinity with the languages of the eastern part of the Indonesian region where it is difficult to draw a line between Indonesian and Melanesian.

The final chapter of the work under review deals with the position of the Indonesians in general and the Timorese in particular in a systematic classification of races, admitting that the available data are not all that could be desired. The author remarks that the current view of the ethnology of the Malay Archipelago is that the existing peoples are the result of a succession of waves of migration from Asia, and suggests an alternative hypothesis by which Timor, and Insulind in general, may have been a region in which an original human stock has been differentiated into divergent types. On this hypothesis, he writes, "we are induced to see in the Proto-Malay of Timor the representative of ancient human stock in evolution. Neither truly Europoid, nor Mongoloid, nor Negroid, nor Veddo-Australoid, but with characters that are common to several stocks well differentiated at present, he appears to us nowadays as a sort of synthetic type, generalized and undifferentiated, of Palaeontology; not as a mosaic, or a crucible for admixtures that are geographically and socially inconceivable in such a remote isolation, but as a 'central type', or rather a truly 'primeval type', of an evolution still at work". "In Insulandia, instead of an area (as has been conjectured) of intense blending of races from the most varied origins, . . . what confronts us is rather, to all appearances, a primeval centre of ethnical differentiation."

In any attempt to judge the evidence for or against this hypothesis suggested by the author, the ethnologist must take into consideration the evidence from linguistics as well as that from physical anthropology. The presence in the mountains of the interior of Timor of peoples speaking non-Indonesian languages, and the existence of a diversity of Indonesian languages some showing affinities with those to the east and others with those to the west, seem to show that there must have been considerable movements of peoples into Timor at some time in the past.

The present work will be welcome to ethnologists and anthropologists as a study of a region about which our information is scanty. There are maps and many photographs. For those who do not read Portuguese easily there is a section in English (pp. 179–215) giving an abstract of the first seven chapters and a full translation of the final chapter.

A. R. RADCLIFFE-BROWN.

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[1] Capell, A., "People and Languages of Timor", *Oceania*, **14**, 191–219, 311–337; **15**, 19–48.

MEDICINE AND MANKIND

Medicine and Mankind

By Arnold Sorsby. (Thinker's Library, No. 104.) Pp. xii+116. (London: Watts and Co., Ltd., 1944.) 2*s*. 6*d*. net.

THIS is an abridgement of Prof. Sorsby's fuller work of the same title (Faber and Faber, 1941). More than a hundred years ago it was realized by the pioneer reformers who laid the foundations of British public health that the maintenance of health and the effective treatment of disease were much more than a question of doctor and patient. Man is a social organism and must be studied in relation to his environment. It is more advantageous to the community, for example, that a thousand cases of typhoid fever should be prevented by safeguarding the water supply, or by the detection of a carrier of the typhoid bacillus, than that cases of the declared disease should be treated successfully. The lesson has not been readily learned either by the medical profession or the public. When within the last decade medicine became more scientific and the experimental researches of the laboratory were applied at the bedside, the tendency was to regard the patient as a subject for biochemical investigation rather than an individual with an environment, which frequently enough was responsible for, or favoured, the existence of his malady.

The achievements of preventive medicine, particularly in nutrition, tuberculosis and industrial disease, are inculcating a more comprehensive view, while the foundation of chairs of social medicine at Oxford and Birmingham denotes a further advance in this direction. This aspect of medicine, which regards health and disease as an unstable physicochemical balance constantly responding to changes in the outer world, is well developed in Prof. Sorsby's little book. To this end he employs a wealth of medical examples relating to the genetic, endocrine, nutritional and toxic characters of disease. The book is a little difficult for the non-medical reader, but the author assists him by providing a useful glossary of medical and scientific terms.

A. S. M.

A PLAN FOR RESEARCH IN THE UNITED STATES

THE report of Dr. Vannebar Bush, director of the Office of Scientific Research and Development, to the President of the United States, now published under the title "Science—the Endless Frontier"*, was prepared in response to President Roosevelt's letter of November 17, 1944, asking for recommendations on four specific points. The four questions asked were, first, what could be done, consistent with military security, and with the prior approval of the military authorities, to make known to the world as soon as possible the contributions which have been made during the war effort to scientific knowledge; second, with particular reference to the war against disease, what could be done to organize a future programme of work in medicine and related sciences; third, what could the Government do to aid research activities by public and private organizations; and fourth, could an effective programme be proposed for discovering and developing scientific talent in American youth, so as to ensure the continuance of scientific research on a level comparable to that attained during the War. In his letter of transmittal, Dr. Bush states that he interpreted these questions to relate to the natural sciences, including biology and medicine, and the report includes as appendixes the reports of the distinguished committees on which Dr. Bush called for advice and on the findings of which his own recommendations are based.

The main recommendation for implementing the general finding and conclusion of the report that the Federal Government should accept new responsibilities for promoting scientific research and the development of scientific talent in youth is the creation of a National Research Foundation. The Foundation proposed would be responsible to the President and to Congress, while assuring complete independence and freedom for the nature, scope and methodology of research in the institutions receiving public funds and retaining discretion in the allocation of funds among such institutions. Such responsibility, Dr. Bush urges, is the only means of maintaining the proper relation between science and other aspects of a democratic system, and he considers that a government programme of support for scientific research and education must be based on four further principles: stability of funds over a period of years to enable long-range programmes to be undertaken; the agency administering such funds should consist of citizens selected only on the basis of their interest in, and capacity to promote, the work of the agency; the agency should work through contracts or grants to organizations outside the Federal Government and should not operate laboratories of its own; and support of fundamental research in colleges, universities and research institutes must leave the internal control of policy, personnel, and the method and scope of the research to the institutions themselves.

Accordingly, the Foundation proposed would consist of nine members appointed for, say, four years, and selected by the President in virtue of their interest in and understanding of scientific research and education. They would appoint a chief executive officer as director, and establish initially five divisions, covering medical research, natural sciences, national defence, scientific personnel and education, and publications and scientific collaboration. The function of the Division of National Defence would be t support long-range scientific research on militar matters, leaving to the Services research on th improvement of existing weapons. The Division o Scientific Personnel and Education would be responsible for the support and supervision of the grant o scholarships and fellowships in science, while that fo publications and scientific collaboration would b responsible for encouraging the publication o scientific knowledge and promoting internationa exchange of scientific information. In this field th powers of the Foundation would include the provision of financial aid for international meetings, associations of scientific societies, and scientific research programmes organized on an internationa basis. Emphasizing that the success of the Foundation in promoting scientific research will largely depend on the co-operation of organizations outside the Government, Dr. Bush suggests that while in its grants to, or contracts with, such organizations the public interests must be adequately protected, the organization should be left with adequate freedom and incentive to conduct research. Normally, the public interest would be adequately protected if the Government received a royalty-free licence for government purposes under any patents resulting from work financed by the Foundation. There should be no obligation on the research institution to patent discoveries made as a result of support from the Foundation, and no absolute requirement to assign all rights in such discoveries to the Government. Legislation should leave to the members of the Foundation discretion as to its patent policy, so that patent arrangements could be adjusted as circumstances and the public interest require. Rough estimates given in the report provide for an expenditure of 33,500,000 dollars in the first year, rising to 122,500,000 in the fifth year. Of this total, five millions, rising to twenty, are for medical research, ten each for the Divisions of Natural Science and National Defence, rising to fifty and twenty millions, respectively, and seven millions rising to twenty-nine millions for the Division of Publications and Scientific Collaboration.

In arguing for these recommendations, Dr. Bush points out that without scientific progress the national health would deteriorate, the nation could hope for no improvement in its standard of living, or for increased employment, or indeed maintain its liberties against tyranny. As yet, however, there is no national policy for science, and the Government has only begun to utilize science in the nation's welfare. No government body is charged with formulating or executing such a policy, nor is any standing committee of Congress devoted to the subject. There are areas of science in which the public interest is acute, but which are likely to be cultivated inadequately if left entirely to private support, and we are entering a period when science needs and deserves increased support from Government funds. The colleges, universities and research institutes are the centres of fundamental research and the wellsprings of knowledge and understanding. So long as they are vigorous and healthy, and their scientific workers free to pursue the truth wherever it may lead, new knowledge will flow to those who can apply it to practical problems in government, industry and elsewhere. Many of the lessons learned in the war-time application of science can also be profitably applied in peace, and the rigid controls imposed for security reasons should be removed to restore free-m of inquiry and the healthy competitive scientific rit so necessary for expanding the frontiers of ence. Scientific progress on a broad front results m the interplay of free intellects, working on jects of their own choice as dictated by their own riosity to explore the unknown.

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* "Science: the Endless Frontier". A Report to the President by Dr. Vannevar Bush. Pp. ix+184. (Washington: G.P.O., 1945.)

Discussing next the war against disease, Dr. Bush ists that striking advances in medicine during the ar have been possible only because of the mass of applied scientific data accumulated through fundantal research in many fields before the War. ogress in combating disease depends on an exnding body of new scientific knowledge, and any tension of medical facilities must be accompanied an expanded programme of medical training and search. The need for broad and fundamental dies is stressed, since progress results from disveries in remote and unexpected fields of medicine d the underlying sciences. Government initiative d support for the development of newly discovered erapeutic materials and methods can also reduce e time required to bring the benefits to the public. ne primary place for medical research is in the edical schools and universities; but the traditional urces of support, largely endowment income, undation grants and private donations, are diminhing. There is no immediate prospect of a change this trend, and research costs have steadily risen. dustry is only to a limited extent a source of funds r fundamental medical research, and to maintain e progress in medicine which has marked the last wenty-five years, the Government should extend nancial support to such research in the medical chools and in the universities, through grants both or research and for fellowships.

Under the heading "Science and the Public Velfare", Dr. Bush emphasizes first the imperative ecessity, from the point of view of national security, of more, and more adequate, military research in eace-time. This is primarily a responsibility of the overnment, and it requires a permanent, independent civilian-controlled organization, having close iaison with the Army and Navy and the clear power o initiate military research which will supplement and strengthen that carried on directly under the control of the Army and Navy. Equally, scientific research is essential to achieve the goal of full employment; a nation which depends on others for its new fundamental scientific knowledge will be slow in its industrial progress and weak in its competitive position in world trade, regardless of its mechanical skill.

From the figures collected by Dr. Isaiah Bowman's Committee on this question, Dr. Bush concludes that expenditure on scientific research by American industry and the Government—almost entirely on applied research—has almost doubled between 1930 and 1940. Whereas in 1930 this expenditure was six times as large as research expenditure of the colleges, universities and research institutes, by 1940 it was almost ten times as large. Moreover, while the research expenditure of the colleges and universities increased by one half during this year, that of the endowed research institutes slowly declined; and accordingly Dr. Bush urges that to enable the colleges, universities and research institutes to meet the rapidly increasing demands of industry and Government for new scientific knowledge, public funds should be used to strengthen their resources for fundamental research. Beyond this, the Government could encourage industrial research by amending the internal revenue code to remove present uncertainties as to the deduction of research and development expenditure as current charges against net income; but while it is also important that the patent system continue to serve the country in the manner intended by the constitution, Dr. Bush recommends that specific action with regard to the patent law should be withheld pending the submission of a report on that subject. Meanwhile, the Government should take an active part in promoting the international flow of scientific information, and in this connexion, in addition to sponsoring international scientific congresses, Dr. Bowman's committee advocated the establishment of international fellowships and, as an experiment, the appointment of scientific attachés serving in selected United States embassies.

Dealing with the means for providing an adequate supply of scientific talent, Dr. Bush believes that the United States has drawn too heavily for nonscientific purposes upon the great natural resources which reside in its trained young men of science and engineers, and that with mounting demands for scientific workers both for teaching and for research, the United States will enter the post-war period with a serious deficit in trained scientific personnel. If ability, and not the circumstance of family fortune, is made to determine who shall receive higher education in science, constantly improving quality should be assured at every level of scientific activity. To meet the immediate deficit the Armed Services should comb their records for men who, prior to or during the War, have given evidence of talent for science, and make prompt arrangements for appointing those who remain in uniform, as soon as militarily possible, to institutions where they can continue their scientific education. They should also see that those who study overseas have the benefit of the latest scientific developments. To encourage and enable a larger number of young men and women of ability to take up science as a career, as well as gradually to reduce the deficit of trained scientific personnel, there should be adequate provision of undergraduate scholarships, graduate fellowships and fellowships for advanced training and fundamental research.

Details of such a programme providing 24,000 undergraduate scholarships and 900 graduate fellowships are worked out in the report of the Committee on the Discovery and Development of Scientific Talent, of which Mr. H. A. Moe was chairman, forming Appendix 3 to Dr. Bush's report. This report covers both long-term and short-term plans, and includes some analysis of the loss of able students to higher education, and data on training of personnel for science and technology.

Finally, Dr. Bush, pointing out that scientific workers have been diverted to a greater extent than is generally appreciated from the search for answers to the fundamental problems on which human welfare and progress depend, urges the necessity of promptly lifting security restrictions to the diffusion of scientific knowledge. In view of the need for co-ordinated policy, he recommends the establishment of a board consisting equally of scientific workers and military men, to decide upon the release of information from military classification and to control the release for publication of scientific information which is now classified. Measures which will encourage and facilitate the preparation and publication of reports should be adopted forthwith by all agencies, government and private, possessing scientific information released from control.

The greater part of the published report is occupied by the four appended reports of the Committees already mentioned. In addition to those of the Moe and the Bowman Committee, these include the report of the Medical Advisory Committee, with Dr. W. W. Palmer as chairman, and the report of the Committee on Publication of Scientific Information, of which Mr. Irvin Stewart was chairman. The longest of these reports is that of Dr. Bowman's Committee, and this report contains a wealth of information of interest to scientific workers. In addition to points already mentioned, it stresses four important changes in existing practices as desirable to increase the effectiveness of research done within the various departments and laboratories of the Federal Government. First, since the most important single factor in scientific and technical work is the quality of personnel employed, establishment of a separate branch of the Civil Service in the United States for scientific and technical positions is recommended. Second, there should be a general up-grading of positions and salaries in the scientific service, with careful selection of new talent; third, appropriations to the principal government scientific departments should be made in lump sums for broad programmes of research extending over several years; and fourth, a permanent science advisory board should be created to consult with government agencies and to advise the executive and legislative branches of government as to the policies and budgets of government agencies engaged in scientific research.

Besides the appreciation of the national research budget, this report gives an analysis of research expenditure in American universities and colleges, and details the more important general principles on which grants to universities should be based: the funds supplied to the universities should be used for the support of significant research with special emphasis on the position of the universities as the chief contributor to pure science; the board allotting the funds should assure itself that the universities have competent and adequately trained personnel to guide the studies; the grants should be made in such a way as to avoid control of the internal policy of the universities, leaving them full responsibility for the administration of the grant after it is once made; and a constant effort should be made to improve the general level of research in institutions of higher education. A further appendix to this Committee's report directs attention to problems of library aids, including inter-library co-operation, abstracting and translating, bibliographic and reference services.

STRUCTURE, DEGENERATION AND REPAIR OF NERVE FIBRES*

By J. Z. YOUNG, F.R.S.

NERVE fibres have become greatly elongated for their function of conduction, but each yet remains essentially a bag, surrounded by a membrane, with the nucleus separated in a special region, the nerve cell body, at one end. It is difficult to obtain a true representation of the immense disproportion between the length and breadth of these cells. The cell body of a mammalian motor fibre is an irregular star-shaped structure about 1/10 mm. in diameter. Attached to this is the axon process which is 1/50 mm. in diameter or less, and yet oft as much as 1 metre in length. Even in the ve shortest peripheral nerve fibres, the axon is 1,0 times as long as it is broad. In very many mot fibres in man the disproportion is 10,000 times. B some of the longest sensory fibres, more than 1 met in length, are less than a tenth of the thickness these motor fibres and the disproportion here mu often approach one million times.

The really astonishing thing is that the cell bod exerts a very immediate influence along this extende fibre attached to it. If a nerve fibre be cut, howev far from the centre, the isolated peripheral portio will begin within a few hours to show differenc from the central part. Ultimately the isolated pa will wither away and disappear, whereas from th central end new processes will be put out. Ho does the nerve cell body produce its control alon such a very narrow thread? Investigation is fo tunately helped by the fact that not all nerve fibre are so very small. Giant nerve fibres are found i some cold-blooded animals, reaching a diameter u to 1/10 mm. in fishes, rather larger in some crustacean and worms. Much the largest nerve fibres of all ar found in the squids, where they range up to 1 mm in diameter and are very suitable objects for analysi and experiment.

Since nerve fibres serve to conduct messages, it i perhaps natural that we should tend to look upo them as wires. The analogy of telegraphic communication is almost too strong to be resisted; but it is in many ways misleading. The inside of a nerve axon is not a rigid structure but a viscou fluid. The large fibres of the squid show this most clearly, for when they are cut across, the content come flowing out from the end. That the substance of a mammalian nerve fibre is also liquid, or at least can be made to flow, is shown by the experiment of crushing it, say with forceps, and then immediately fixing by immersion in alcohol and making suitable microscopic preparations. The material will be found as large masses on either side of the crushed region, from which it has been driven. There is now reason to suppose that not only is the material of the axon liquid, but also that it can flow down the fibre during life. If a mammalian nerve be cut or crushed and the ends examined one hour later, the material of the axons will be symmetrical in the two stumps. But by five hours after the operation the two ends can be distinguished: the axon material reaches more nearly to the cut surface in the central than in the peripheral stump. By the second day the material at the central end is already pouring out into the gap, the central axons becoming reduced in volume. This outpouring suggests that there is a pressure within the fibres which must originate within the cell body. Weiss[1] has recently shown this pressure very clearly by constricting a nerve, which leads to a damming up of the axoplasm central to the constriction. If the cuff is then released the material soon flows forward again. We do not yet know how fast the flow normally proceeds. There may be a continual leak over the surface of the fibre, but the internal movement must be at most very slow, and no doubt the behaviour is very far from that of a true Newtonian liquid.

Although the substance of the nerve fibre can flow, there is considerable regularity of organization of the molecules within it. Evidence of such regularity is seen in the form of 'neurofibrils' in its substance, and also in the birefringence of the axoplasm. The chemist is now becoming more familiar with such tes of crystal-like organization of proteins within quid, for example, in the case of the virus proteins, d it is interesting that there is evidence that a ge part of the proteins which can be extracted m squid nerve fibres shows some resemblance to us and nucleo-proteins. Moreover, in suitable circumstances, axons will contract into spirals, giving ures which recall chromosomes. The nerve fibre, en, like other living tissues, shows a considerable gree of regularity of its component molecules. It possible that this regularity is preserved under the luence of the pressure down the fibre, just as the bstance of some 'dilatant' liquids becomes regularly ranged and solid under stress. It is not surprising at there should be an elaborate arrangement of e molecules which make up the substance of the rve fibre, to ensure the proper ordering of all the ocesses which make it able to conduct, and recharge after it has conducted.

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* Substance of a Friday Evening Discourse delivered at the Royal Institution on March 16.

Around the axon of many vertebrate nerve fibres another liquid material, the myelin, with regular mellæ of phosphatide and protein molecules. This not continuous over the whole surface but is broken nto segments by gaps, the nodes of Ranvier. Covering ch segment of myelin is a thin, fenestrated veil of rotoplasm, the cell of Schwann, with a nucleus near e centre of the segment.

These viscous liquid substances which make up the erve fibre are all enclosed in a more rigid tube, the eurilemma. They do not, however, remain in stable quilibrium within it, like liquids filling a tube of lass, but show a distinct tendency to develop an nduloid outline and to break into round or oval rops. This behaviour is characteristic of a cylinder f liquid under surface tension. Since the theoretical work of Thomas Young and of Laplace, and the practical as well as theoretical demonstrations of Plateau, Rayleigh and Darling, it has been known hat a cylinder of liquid remains stable only if its ength is less than its circumference. Plateau showed this by experiments with soap bubbles, and the same phenomenon is seen every day in the drops on a spider's web or the annoying irregularity of a coat of varnish applied to a wire. If the liquid is of high viscosity, the maximum stable length of the cylinder may be increased by many times, but is still finite.

Remarkable unduloid outlines are often seen near the ends of nerve fibres which have been cut and immediately fixed in alcohol. If fibres are teased out in a suitable salt solution, they usually show an unduloid outline along their whole length. Moreover, the waves are related to certain cracks in the myelin known as the incisures of Schmidt-Lantermann, which are always found at the troughs of the waves, as if they were produced by the straining of the lamellæ of the myelin by the stress put upon them in assuming an unduloid outline.

Perhaps even more interesting is the evidence of the operation of surface tension in the degeneration of the peripheral portions of the fibres after a nerve has been cut. In the fibres of rabbits' nerves, the break-up begins to be apparent during the second day after the severance. First the unduloid outline becomes more marked and then the myelin breaks into ovoid segments, shorter than the original segments of Ranvier. The process goes on so slowly that in a nerve taken at a suitable time all stages can be seen. A thin neck is formed at the point of constriction, and when the break finally occurs a small intermediate droplet is often left between the two neighbouring segments. Sometimes still smaller secondary droplets lie on either side of the main one. This is exactly the behaviour seen when droplets divide under surface tension. Darling showed the neck droplets very clearly by photography of the separation of a drop of liquid falling slowly through another liquid of almost equal density.

While this break-up is going on in an isolated piece of nerve, there are probably also many other changes in the physical and chemical properties of the substances concerned. But it seems reasonable to suggest that the primary change which constitutes the degeneration of a nerve fibre is a breaking up under surface tension of the viscous liquid cylinders of axon and myelin into shorter segments and ultimately into spheres. We can then go on to suggest that the cell body normally opposes this tendency of surface tension to break up the fibre by blowing it up from the inside. We have already seen that there is good evidence for the existence of a pressure within the axon, and this may well be the agent which presses the contents against the more rigid tube wall and thus maintains the cylindrical form. If the material of the axoplasm shows dilatancy it is possible that it is normally kept rigid under the pressure and only breaks up when it becomes more liquid after the pressure is removed. The tendency to form an unduloid outline is, however, present all the time, and perhaps manifests itself, even during life, in the formation of the incisures of Schmidt-Lantermann. When a nerve fibre has been severed, the head of pressure is cut off and the surface tension gradually causes the fibre to divide.

At this point the physicist will want to ask all sorts of questions, particularly about the relationship between the surfaces of the myelin and the tube in which it runs. It might seem that if the liquid contents altogether fill the tube there should be no break-up of the cylinder into ovoids, just as the mercury does not, usually, break up in a thermometer. But the tube around a nerve fibre differs from the brass, glass or rubber tubes with which we are familiar in that its wall is permeable to water and salts, and it seems likely that a cylinder of liquid fatty material will not remain stable within such a tube, since water can run in to fill the spaces produced when new surfaces are formed by the unduloid. But we must leave this and many other such questions for the physical chemists, and before we pass to consider the functioning of a nerve merely note that this hypothesis gives the possibility of a very elegant explanation of the genesis of the nodes of Ranvier. If the myelin is a viscous liquid it will tend to form, as it is laid down during development, not a continuous cylinder but very long drops. When an animal is young its myelin segments are short, the initial periodicity being about 150 μ. Though this is certainly very long for a droplet of 3 μ in diameter, it is not impossible if the myelin is a very viscous fluid and enclosed in a tube. Ranvier himself, when he described the nodes, suggested that the myelin is included in the Schwann cell as the drop of fat is in a fat cell. It seems that his analogy may be very near to the truth.

This examination of one aspect of the composition of nerve shows the lines on which one can proceed in trying to give an account of the structure of a nerve fibre. It will be seen that some progress can be made towards a description in terms of the categories of the fundamental sciences. We can begin to know the chemical composition of the parts, substituting moderately exact and general terms such as phosphatide and protein for peculiar ones such as myelin or neurilemma. This is already a great advance, but we can go a little further in indicating how these liquid substances are held in their state, which is not one of equilibrium, by a pressure originating from the nerve cell body. Of course, the physicist will wish for very much more precision in all this, and it is much to be hoped that he will help us to provide it. The histologist can only show the lines along which he believes that it may be sought.

So far we have scarcely touched on the fact that a nerve fibre only remains as it is because it has a function, that is to say, it plays a part in the maintenance of the life of the whole body. Its function is, of course, to conduct messages: from sense organs to centres and back again, thence to muscles. There is much evidence that the message is propagated by the discharge of the previously charged surface of the nerve fibre. A difference of electrical potential, the resting potential, exists between the inside and outside of a fibre, and it has long been suggested following Nernst and Bernstein that this arises as a result of the permeability properties of the surface membrane. If the fibre was permeable to potassium but not to anions, then the former, migrating away from the surface, would form a layer held by the attraction of the residual charge left by their departure. The effect of 'stimulation' is then suggested to be to increase the permeability, allowing a leak which produces a flow of current through neighbouring regions. This current itself stimulates other parts of the surface and so the process propagates.

The inside of nerve fibres, like that of other cells, certainly contains much potassium. By analysis of the contents of single squid nerve fibres, exact estimation has been possible and it has been shown that there is more than thirty times as much potassium inside as out. However, there is considerable evidence that the nerve does not work as a simple diffusion battery. There is still much uncertainty as to the actual potentials involved and as to the permeability to the various ions. Steinbach and Spiegelman[2] have recently shown that the squid fibres are quite freely permeable to sodium, though this does not usually occur within them. It has been shown that during activity potassium does leak out of nerve fibres[3], and application of potassium to the outside of a fibre reduces the resting potential[4]. However, the relationship between potential and the logarithm of the potassium concentration is not always linear as would be expected on the theory, and Shanes[5] suggests that the effect of the potassium may be at least in part to depress the respiratory processes necessary to maintain the potential.

One of the great difficulties of the subject has been that most of the data of nerve physiology have been obtained by the use of bundles of nerve fibres, whereas the verification of the hypothesis evidently requires exact knowledge about the conditions during activity of a single fibre. In the years immediately before 1939, further very direct evidence on the subject was accumulated by the use of the nerve fibres of the crab and especially those of the squid, which are so large that a wire can be inserted inside them. Hodgkin and Huxley[6] and Curtis and Cole[7] have shown that there is, in fact, a large 'resting' potential difference across the surface, which is not seriously interfered with by the presence, even for many hours, inside a fibre, of wire as large as a quarter of its diameter. This certainly suggests that the battery is essentially at the surface. The action potential produced by activity of a limited section of the membrane betw inner and outer electrodes can be recorded and sh to be identical whether the fibre is stimulated at end or the other. However, one of the most expected results has been the demonstration that action potential of a single stretch of membr recorded in this way is diphasic, and not simply abolition of the 'resting' potential. No explanat of this is yet forthcoming.

Other data obtained from these squid-fibres prov further evidence of the changes which occur dur excitation. Thus Curtis and Cole[7] have shown t during the passage of the impulse there is a fall resistance across the membrane, coinciding with peak of the action potential spike. There is thus n very strong evidence of an actual surface cha during excitation. But Cole and his collaborat have gone further yet in studying the electri characteristics of the surface by the application direct and alternating currents across it. They ha revealed that the nerve membrane acts as a rectifi that is to say, presents very different resistance inward and outward current flow. This is not su prising in view of the very marked asymmetry concentration between inside and outside. M unexpected is that there is an element present whi has the electrical characteristics of an inductan that is to say, the potential difference across it proportional to the rate of change of current. V usually associate such effects with magnetic fiel and it is at first a little difficult to accept the idea an inductance in a liquid system such as a ner fibre. But there are several ways in which it can understood as a property of a layer of regular arranged molecules, such as we have every reason think exists at the surface of a nerve fibre.

This work then gives us direct evidence that the are changes at the surface of a nerve fibre at th moment of activity. Other workers have produce equally direct evidence that the electrical curren which flows as a result of this change is actually th agent that stimulates neighbouring points and thu sets up a disturbance which is propagated. Fo tunately, there is already available a large body c evidence about the circumstances in which a electrical current excites a nerve, built up by th labours of many able experimenters from v. Krie and Lucas onwards to the more recent work of A. V Hill and his school[8]. Using this work as a background Hodgkin[9] was able to show that the activity of region of nerve does in fact produce an increase o excitability in front of itself. He did this by coolin or compressing a single nerve fibre of a crab until i just failed to conduct. He tested the excitability o the region beyond the block during the time immediately after the arrival of an impulse at the block, and found that a far smaller electrical impulse than usual was then necessary to excite the fibre. This demonstrates that the transmission along the fibre is by means of these electrical currents flowing in front of the active region. Moreover, Hodgkin also showed that, as would be expected, raising the resistance outside the fibre lowers the rate of conduction, whereas decrease of the resistance increases it.

This abundant evidence makes it very likely that the hypothesis is correct in its general outline, though much remains to be done to make it satisfactory. The degree to which it is successful may be judged by a recent attempt by Offner, Weinberg and Young[10] to produce equations for a circuit equivalent to that of the nerve on these assumptions. The data of Cole and others provide physical measurements for the constants of these equations, and the measure of the completeness of the hypothesis is that these equations predict the conduction velocity of a nerve fibre such as that of a squid with remarkable accuracy. Further, such considerations suggest that the decreased internal resistance provided by increase of diameter of nerve fibres will lead the conduction velocity (c) to grow larger with increased fibre diameter (d), but only slightly, the predicted relationship being $c = kd^{-1/2}$. Pumphrey and Young[11] measured the conduction velocity of a number of squid fibres of various diameters and found approximately this relationship, the data giving $c = kd^{-0 \cdot 6}$ as the best fit. Evidently increase of fibre diameter is a very poor means of obtaining rapid conduction. Indeed the squid with its immense and cumbrous fibres, of a millimetre in diameter, can only reach a conduction velocity of 25 m./sec. This is where the myelin sheath comes in. Nerve fibres covered with a thick layer of myelin conduct much faster than those without it. Thus the earthworm or the prawn obtains a rate approaching that of the squid by the use of fibres of only one tenth of the diameter, but surrounded by myelin layers. Among vertebrates the same method has been further perfected, so that among cold-blooded forms such as the frog rates of 50 m./sec. are obtained with fibres only 20 μ in diameter. For a full understanding of this effect of the myelin we shall have to await further investigation of single medullated fibres, which is only beginning to be technically possible.

From this very brief sketch it will appear that we already know a good deal about the functioning of nerves. We now have a moderately good general theory to describe the method of response and conduction, using the basic categories of physics and chemistry. This is a big step from the special theories from Descartes onwards, which treated of a particular nervous flow. But what we know is scarcely more than enough to stimulate our appetites and remind us of our ignorance. There are many intriguing facts which cannot be fitted into the general picture at all; for example, v. Muralt has recently shown by a most elegant method that a nerve fibre leaks aneurin when it becomes active. Again, for some years it has become increasingly plain from the work of Dale and others[12] that the method by which a nerve message produces an effect in a muscle or other organ at its end is the production of tiny amounts of very active stimulating substances such as acetyl choline. How the production and action of this substance is linked with the conduction of the nerve impulse is a most baffling problem. One cannot help suspecting that the answer will be found in the events which go on in the molecules of the nerve surface.

We have now seen that it is indeed difficult enough to give a general account of the composition, degeneration and function of the nerve fibre. But far worse problems present themselves when we try to describe its history, how it comes to exist in its present state, ready to function. Indeed, no exact treatment of these general embryological and evolutionary problems is yet possible. But we have no right to suppose that it never will be achieved; and it is interesting to make a preliminary attempt to examine the forces by which a nerve fibre is brought to its adult functioning state. One difficulty about exact study of a developing organism is that it is so small that quantitative experiments are hard to perform. This difficulty can partly be overcome in the case of nerve fibres by studying the processes by which they undergo regeneration after injury, for these constitute a kind of development in the adult state. We have seen that after a nerve has been cut across, the axons and myelin break down in the peripheral stump, and are ultimately removed. New axoplasm is put out from the fibres of the central stump and flows back into the tubes left after the degeneration. Along these they may be led back to make connexion with sensory or motor endings similar to their original ones. Thanks largely to the work of Weiss[13], we now understand something of the forces which lead these regenerating streams along suitable surfaces.

Before a new fibre is fully remade, it must acquire the diameter and myelin sheath which it possessed before. We have recently been studying the factors which control the diameter reached by the new fibres. Our first hypothesis was that the size of the parent fibre determines that of the new one, large central making large peripheral fibres, and vice versa. It proved that there is an effect of this sort, and also an influence of the size of the peripheral tube in which the fibres run. But the most powerful factor is one we had not expected to find. New fibres that become connected with the periphery, muscle, gland or sense organs in the skin, become larger than others which fail to become so connected[14]. This means that of the many fibres which enter the degenerated stump, those that make connexion increase, apparently at the expense of the rest. This increase with function should perhaps have been expected. Muscles and glands are well known to show such a functional hypertrophy, but it is a measure of the danger of the analogy of telegraph wires, to which we have already referred, that we had not in fact expected to find that conductors get bigger by functioning. Of course, it is now necessary to analyse the effect much further, and to find out exactly how it is produced, whether by connexion alone or by functioning after connexion. Quite intriguing prospects open if it be true that use increases the volume of nervous tissue. Atrophy of the brain by disuse may be more than a conception of the schoolboy and the comic papers. There is, indeed, already evidence of this. Conversely, exercise and practice may produce skill partly by actually increasing the size, speed and synchrony of conduction in the nerve fibres. However, these are speculations which must be tested in the future.

We see then that a nerve fibre consists of substances the properties of which can be largely defined in physico-chemical terms and which are subject to physico-chemical forces. However, these substances are not in a state of equilibrium, but are maintained in a steady state as part of a complicated system, the organism. The whole elaborate organization of the animal only remains intact because of the functioning of its parts. The special function of a nerve fibre is conduction, and if the nerves conduct wrongly the organization is seriously impaired or actually destroyed. We see this only too clearly in the useless limbs produced by severance or damage to nerves. With no fibres to conduct a sense of pain the fingers are often burned by a cigarette or at the fire. Survival has only been possible because by the processes of development we are given nerve fibres, and all the other organs, with the correct function. This process of development can itself partly be described in terms of physico-chemical forces. We have seen that during nerve regeneration we can discover how the new fibres are formed when the material emerging from the central stump makes contact with the Schwann cells emerging from the peripheral. We can examine quantitatively the forces of pressure and attraction which produce the outgrowth. Again, the size of the new fibres is determined partly by that of the parent fibres, partly by the peripheral tubes into which they enter. But we found that another factor also very much influences the fibre size, namely, whether functional connexion is made or not. Here we see a tendency—not easily referable to ordinary physical and chemical forces—to develop in such a manner as shall be suitable for the preservation of the whole system.

Indeed, this tendency is present, if we look a little closer, behind and in addition to all the physical forces which we have been discussing. The nerve fibres only grow as they do and conduct as they do because during long ages suitable substances for this purpose have been collected together. This has been the work of that same tendency to act in a manner which ensures preservation, assisting the equally fundamental tendency to increase by growth, which is the driving force of evolution. Each type of organism produces more like itself, but not exactly like. What we should perhaps call a tendency to vary also plays a part, by ensuring a continual supply of new types to meet the needs of a changing world.

So we find that we can begin to apply the methods of physics and chemistry in biology, and thereby obtain solutions of our problems which are both more exact and more general than can be reached in biological terms alone. But such methods do not serve to describe all of the phenomena which are presented by the living organism. Unless physicists are prepared to say that their science discovers in all matter tendencies of self-preservation, of increase, of multiplication, and of variation, we must say that these are the special characteristics of living organization, which it has preserved since life first appeared long ago.

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OBITUARIES

Dr. P. Pelseneer

PAUL PELSENEER, who died in Brussels on May 5, 1945, was well known to a wide range of scientific men through his connexion with the International Association of Academies and with the International Research Council (now called the International Council of Scientific Unions) which was founded in its place in 1919. But he will be especially remembered by zoologists for his extensive knowledge of molluscs, ranging from embryology to parasitism, and abov all for his anatomical work on this group.

Pelseneer was born in Brussels on June 26, 1863 and graduated at the University of Brussels. He wa a research worker at the laboratories of Naples Villefranche, Roscoff and Wimereux. From 188 until 1918 he held a professorship in the Ghen Teachers' Training College. In 1919 he was appointe permanent secretary of the Royal Academy o Belgium (of which he had been elected a member in 1899), a post he held until almost his last days.

Pelseneer was well known in Britain, and proud o having worked with T. H. Huxley on *Spirula* in 1894 ; their joint work was published as one of the *Challenge* reports, to which Pelseneer had already contributed accounts of the Pteropoda and of the anatomy of deep-water molluscs. The best text-book on Mollusca is that written by Pelseneer for Ray Lankester's "Treatise on Zoology", of which it forms part 5 (1906, translated into English by Gilbert Bourne). He is responsible for the arrangement of bivalves on a primary basis of gill structure, that is now found in most general works on zoology ; it was put forward in 1891, modified in 1906, and his final views are to be found in his report on the anatomy of the *Siboga* lamellibranchs in 1911. In his early studies on the nervous system of gastropods, he showed that orthoneury does not exist in the group Euthyneura, but that the animal has undergone torsion and then untwisted sufficiently to show no chiastoneury. Much of his work is stimulating reading, always clearly expressed, wide in outlook, well illustrated and fresh with new ideas.

One can only refer briefly here to the quantity of work Pelseneer accomplished, which included such divers subjects as the relation of the osphradium to the visceral ganglia, the eyes of bivalves, hermaphroditism, sinistrality, the effect of temperature variation on larvæ, the relative proportion of the sexes, regeneration, hybridism, the chemical composition of the shell, trematode and copepod parasites. His fame rests primarily on his important contributions to morphology, classification, phylogeny and evolution. Late in life he collected into one book, "Essai d'Ethologie zoologique d'après l'étude des mollusques" (662 pages. Brussels, 1935) a concise and monumental survey of almost all that is known of the habits, relations and environment of molluscs, enriched by his own wide research experience. Undoubtedly he ranks as a great zoologist and one of Belgium's greatest scientific workers.

R. WINCKWORTH.

Prof. E. Barclay-Smith

PROF. EDWARD BARCLAY-SMITH, emeritus professor of anatomy in the University of London, died in London on July 5, aged eighty-three. Educated at Brighton College and at Downing College, Cambridge, he graduated M.A. and M.B. in 1890 and M.D. in 1893. Choosing anatomy as a career, he served as demonstrator to Alexander Macalister and was later University lecturer in advanced human anatomy at Cambridge. His faculty for close and accurate observation, his gift of graceful yet forceful exposition, and his remarkably sound and meticulous knowledge of general and topographical human anatomy, established his reputation as a teacher. In 1915 he was appointed professor of anatomy in the University of London, holding the chair at King's ollege until 1927, when, upon retirement, he was reated emeritus professor. He served King's College nd the University of London with selfless devotion, is professional eminence and administrative abilities arning fitting recognition. He became dean of the medical faculty in 1920, a member of King's College ouncil in 1925, and a fellow of that College the same ear: he represented King's College on the committee of management of its associated hospital, acted as chairman of the University of London Board of Studies in Human Anatomy, and was chairman and secretary of the Board of Intermediate Medical Studies. Much appreciated as an external examiner, he served in that capacity the Universities of Cambridge, Durham, Manchester and Birmingham, and was representative of the Royal College of Physicians upon the Conjoint examining board.

A teacher rather than an investigator, Barclay-Smith contributed little to anatomical literature, but ncorporated his wide and exact knowledge in 'Buchanan's Manual of Anatomy", of which he was oint editor. His abiding and scholarly interest in the history of anatomy and anatomical nomenclature was manifested in various little memoirs—gems of erudition—upon classical and neo-classical anatomical terminology.

To the welfare of the Anatomical Society he devoted years of disinterested, unremitting labour, an Argus in its interests and a most gentle Nestor to its younger members. Joining the Society in 1893, he served for many years on its council and on the editorial board of the *Journal of Anatomy*, was joint recorder of *Proceedings* 1925–31, treasurer 1931–37, and secretary 1919–38, declining the honour of the presidency that, as secretary, he might the better serve his fellow members. The Society's travelling fund, designed to encourage and enable junior provincial members to attend the London meetings, was Barclay-Smith's anonymous foundation. Indeed, the Society owes more to him than to any other, and its present flourishing state is perhaps his truest memorial.

Barclay-Smith's personal qualities—in particular his gentle patience, his unassuming bearing, his winsome charm and his genuine concern for the welfare of his fellows—endeared him to a wide circle of friends, colleagues and students, by whom he was beloved, and by whom his memory will be always cherished.

A. J. E. Cave.

NEWS and VIEWS

Engineering at Queen Mary College:

Prof. E. H. Lamb

Prof. Ernest Horace Lamb retires from the chair of civil and mechanical engineering at Queen Mary College, London, at the end of the present session. He has occupied this chair for thirty-two years, having succeeded the late Prof. D. A. Low in 1913. At the time of his appointment, the Engineering Department at East London College (as the College was then called) was rather small and the laboratory equipment meagre and ill-housed. Prof. Lamb set to work at once to develop an engineering laboratory that should be more worthy of the College and of the University. Permission was obtained to extend the laboratory buildings, and a new hydraulic laboratory had already been erected when the War of 1914–18 interrupted the development programme. From September 1914 until April 1919, Prof. Lamb was away from the College on war service, but as soon after his return as possible he continued the work of development. With the help of the late Principal Hatton, he obtained a grant for equipment of £11,000 from the London County Council and also some useful presentation plant, notably a complete boiler and accessories from Babcock and Wilcox, so that by the end of 1923 the laboratories had been rearranged and re-equipped with modern plant for the study of hydraulics, heat engines and strength of materials. He also designed and equipped an instrument-making department which served the science and engineering departments of the College.

The undergraduate school of engineering at Queen Mary College has grown considerably under Prof. Lamb's direction. In addition, much valuable research has been carried out on temperature distribution and thermal stresses in internal combustion engines, propagation of flame in compression ignition engines and on many other investigations. He has always taken a special interest in the application of theory to those elastic and dynamical problems which are so important in high-speed machinery. Prof. Lamb was a member of the University Board of Studies in Civil and Mechanical Engineering and served as its chairman in 1923. He was also a member of the Faculties of Science and Engineering. From November 1924 until November 1928 he was University Dean of the Faculty of Engineering, and thus occupied this important post when the new statutes under the University of London Act, 1926, were being drafted. He was elected a member of the Senate as representative of the Faculty of Engineering in May 1928 and remained a member until 1934, giving most useful service on the Academic Council and many sub-committees of the Senate.

Prof. Edmund Giffen

Dr. Edmund Giffen has been appointed to the chair of civil and mechanical engineering at Queen Mary College, in succession to Prof. E. H. Lamb. Dr. Giffen had a lengthy practical training with Messrs. Harland and Wolff, Belfast, and took his degree in mechanical engineering at the Queen's University, Belfast, later proceeding to M.Sc. He served for thirteen years at King's College, London, first as lecturer and later as reader in mechanical engineering. In this period, he carried out considerable research work, mainly in connexion with injection processes in compression ignition engines, in collaboration with Prof. S. J. Davies, gaining the degrees of Ph.D. and D.Sc.(Eng.) in the University of London. He was active as a member of College and University Boards and served as chairman of the Board of Examiners for the External Engineering Degree. Since 1940, he has been director of research at the Institution of Automobile Engineers' Laboratories, Brentford. During this period, he has been responsible for a great development in the work of these laboratories and has issued important publications, particularly in connexion with the use of gas-producers. In his career he has thus combined experience of practice, of research, of teaching and administration, and his return to university life will be greatly welcomed.

British Agricultural Attaché at Washington and Agricultural Adviser at Ottawa: Mr. A. N. Duckham, O.B.E.

PROF. ROBERT RAE, agricultural attaché on the staff of His Majesty's Ambassador to the United States of America and agricultural adviser to the High Commissioner for the United Kingdom in Canada, will shortly be returning to Britain. He will be succeeded by Mr. A. N. Duckham. Mr. Duckham has been serving as director of the Supply Plans Division of the Ministry of Food, having joined that Department at the beginning of the War. Among his earlier appointments were those of secretary and manager to the Northern Ireland Pigs Marketing Board and research officer to the Bacon Development Board. He has travelled extensively in Europe and North America to examine the economics of animal husbandry. He acted as adviser to the United Kingdom delegation to the Hot Springs Food and Agriculture Conference in 1943 and was a member of the Food and Nutrition Committee of the interim Commission set up by that Conference and also chairman in the United Kingdom of the 1943 Food Consumption Levels Enquiry Committee of the Combined Food Board. Mr. Duckham took Part I of the Natural Sciences Tripos at Cambridge, and holds the Cambridge diploma in agricultural science with distinction in animal husbandry; he is a research medallist of the Royal Agricultural Society. His published work includes reports on agricultural topics and "Animal Industry in the British Empire" which were issued by the Oxford University Press in 1932.

British Iron and Steel Research Association: Dr. C. F. Goodeve, F.R.S.

THE steel industry in Great Britain has recently announced plans for large-scale re-equipment; in addition, it is to establish a central organization for research, to be known as the British Iron and Steel Research Association, which will be under the direction of Dr. C. F. Goodeve, formerly reader in physical chemistry at University College, London, and since 1942 assistant controller for research and development at the Admiralty. Dr. Goodeve has stated that the present intention is for the industry's own research centres to operate in association with teams already working in the universities, as at Sheffield, Cambridge, Swansea, Glasgow, London, Birmingham and Newcastle. The Association will have its headquarters in London, and it will work through a number of divisions and committees, each serving a particular aspect of the steel industry's interests. In this way it is hoped to ensure that problems of the industry reach the research laboratory promptly and that the results of investigations are properly applied. The Research Association will also collaborate with technical bodies studying the raw materials of the industry such as coal and refractories, and will bring together users and makers of steel for the discussion of common problems. It is stated that the industry will contribute up to £250,000 a year to the new Research Association, the total revenue of which is expected to be about £400,000 a year.

National Certificates in Metallurgy

THE Iron and Steel Institute, the Institution of Mining and Metallurgy and the Institute of Metals have joined forces to establish, in co-operation witl the Ministry of Education, a scheme for Ordinary and Higher National Certificates in Metallurgy fo part-time students who are engaged in industry or other pursuits connected with the science o metallurgy. The certificates will be awarded tc students taking approved grouped courses of in struction at certain technical colleges and schools in England and Wales and reaching a certain standard in the final examinations. Examinations will be conducted by the college or school authorities, but syllabuses and examinations based on those of the City and Guilds of London Institute, Department o Technology, or the regional examining unions may, at their discretion, be submitted. The Ordinary National Certificate will be awarded on the results of senior part-time courses, which will usually occupy three years. They will be adapted to the needs of students who have had full-time continuous education up to the age of 15 or 16 or have completed satisfactorily an appropriate part-time course. Senior courses will include adequate provision for chemistry, physics and mathematics; metallurgy will be introduced at appropriate stages and engineering drawing may also be included. The Higher National Certificate will be awarded on the result of advanced part-time courses. These will be suitable for students who have already gained the Ordinary National Certificate or who have reached a corresponding standard and will normally cover at least two years of part-time study. The courses will provide for more intensive study of various branches of metallurgy and will aim at reaching, within the limits of the subjects covered, the standard of university work.

Certificates will be signed by the presidents of the Iron and Steel Institute, the Institution of Mining and Metallurgy, the Institute of Metals and, on behalf of the Minister of Education, by the Principal of the technical college or school at which the award has been gained. Thus the National Certificates will have a professional and national, as well as a local, value. Higher Certificates which record success in specialized foundry subjects will be countersigned by the president of the Institute of British Foundrymen. It is hoped that the possession of a national certificate in metallurgy will foster in the holder a desire to join one or more of the various institutions whose members are concerned with the study, production and use of metals. In the case of those institutions whose membership involves professional qualifications, the holding of a Higher National Certificate will be of assistance in obtaining admission. The formation of a new professional Institution to be known as the "Institution of Metallurgists" and covering all branches of metallurgy is now nearing completion. Membership will be dependent on the production of suitable evidence of qualification as a metallurgist, and it is believed a Higher National Certificate in Metallurgy will be accepted as qualifying the holder in part for the appropriate grade of membership. Further information on the scheme for national certificates in metallurgy can be obtained from the secretaries of the participating institutions or from the principals of technical colleges or schools.

Pharmaceutical Chemistry, Past and Future

MR. H. BRINDLE, chairman of the British Pharmaceutical Conference meeting in London on July 18, gave an address on the origin and development of armaceutical chemistry. He claimed that in days t long past all chemistry was pharmaceutical emistry and all chemists were pharmaceutical emists. Pure chemistry has emerged from it, but day many chemists are drawn irresistibly away m atoms, valencies, electrons, dipole moments, ., to the chemistry of medicinal substances and us back again to pharmaceutical chemistry. The hemists were really neither chemists nor apothe- ries, and they added little to knowledge of chem- ry. The iatro- or medical chemists should be con- lered the first pharmaceutical chemists, for all who actised chemistry at this time were interested in e subject from the medical, that is, the pharma- utical point of view. Their main aim was to pre- re chemical substances for use in medicine, and eir interest in chemistry as a science was distinctly condary. Paracelsus was the first outstanding tro- or pharmaceutical chemist, and he was followed such as van Helmont, Agricola, Glauber, Scheele, unkel, Davy, Berzelius, Liebig, Wohler and Dumas, name a few only who spent periods of their life apothecaries.

The present course of training for the modern harmaceutical chemist includes a fairly com- rehensive study of synthetic drugs. These are creasing very rapidly in number and complexity. hus since the publication of the "British Pharma- opœia" in 1932, seven addenda have been issued, nd in these have been included about fifty entirely ew synthetic organic drugs. These fifty which have een officially recognized constitute only a very mall fraction of the total number which may be onsidered to have been actually introduced in the hirteen years which have elapsed since the "Pharma- opœia" was published. These facts raise great ifficulties in the design of teaching syllabuses in the ubject, for the lecturer has to consider carefully which should be taught and which can be mitted. Enough chemotherapy should be included o fire the students' imagination regarding its possibilities.

However limited his opportunities for carrying it out, any pharmaceutical chemist worthy of the name must have his mind directed towards research. There is a tendency to divide scientific research of all types into the two main classes of pure and industrial or applied research. Pure research is undertaken with no thought of its application. Its results may add to knowledge but it is not carried out primarily for any benefit which it may confer upon any individual, community or even mankind in general. Yet startling results have resulted from pure research; insulin and penicillin, two of the greatest life-savers science has ever produced, emerged almost accidentally during the prosecution of pure research. Pharmacy must be better organized in research activities. The existing research degrees in pharmacy will stimulate research, and now that more pharmacists are graduating in universities, pharmaceutical research is sure to expand. Grants in aid of such research are urgently needed. Some thirty branches of industry have autonomous research associations financed to some extent by the industry concerned but receiving aid from the Government. Although pharmacy may not be so large or so wealthy as these, and may not be able to support a research institution, it could assist by contributions which would be supplemented by government aid. A body for pharmacy similar to the Medical Research Council should be set up.

Conditioning of Plywood

PLYWOOD has so important a future before it that any research which advances its durability is of importance. In Leaflet No. 65 (Utilisation) of the Forest Research Institute, Dehra Dun, India, a description with plan is given of a simple chamber designed by this Institute for the conditioning of finished plywood. It is pointed out that even thoroughly seasoned veneers pick up a certain amount of moisture from glue during the manufacture of plywood; it is necessary that this moisture should be got rid of, before the article is used, by a process termed conditioning. This process ensures the correct drying and setting of the glue, and prevents warping and buckling. Further, some of the softer hardwood timbers, like the Indian semul (*Bombax malabaricum*), and mango (*Mangifera indica*), are liable to blue stain and mould, and even attack by insects if not well conditioned. The drying room is fitted with steam pipes below the floor, and the sheets of plywood are stacked vertically on trolleys above it. There are inlets for the fresh air and outlet chimneys for exhausting the moist air. It is estimated that freshly manufactured plywood requires twenty-four hours for conditioning, and during this period its moisture content will decrease from about 20 to 8 per cent.

Institution of Electrical Engineers: Annual Report

ACCORDING to the report for the year 1944–45 of the Council of the Institution of Electrical Engineers, total membership on March 31, 1945, numbered 26,665, of which 12,573 were corporate members; 2,639 elections to all classes of membership were made during the previous twelve months. During the year, 682 meetings were held in London and at the local centres. There were eleven ordinary meetings, the Radio Section held eighteen meetings, the Measurements Section eight, the Transmission Section seven, the Installations Section eight, and there were six informal meetings. There are ten students sections. Certain revisions of the by-laws have been effected during the year. The Council has set up a permanent Research Committee to advise in matters connected with electrical research. The Institution continues to be active in matters affecting national service, such as War Office correspondence courses, engineering cadetships, the education and training of students and graduates serving with the Forces, etc. A report dealing with "Part-time Further Education at Technical Colleges—including Courses for those returning from the Services" has been issued. Further substantial progress has been made in the work of drafting various codes of practice.

A committee of the Institution has been set up to prepare regulations for the electrical equipment of aircraft, and one is to be formed to deal with radio requirements for civil aircraft. Panels of lecturers are to be formed for the benefit of both young people and adults, and a series of skeleton lecture notes is being prepared for the use of speakers. This scheme is in addition to that already existing whereby senior engineers are enabled to address university engineering societies. An independent Professional Engineers Appointment Bureau has been set up to meet the needs of professional engineers seeking appointments and employers having staff vacancies to be filled. The Council has endowed a chair of electrical engineering at Cambridge for a period of years. Reference is also made in the Report to the Institution library and publications and to the benevolent fund.

Beit Memorial Fellowships for Medical Research

THE Trustees of the Beit Memorial Fellowships for Medical Research refer in their annual report for the year 1944–45 to the death of Lord Onslow, who had served as a trustee since 1928. They also put on record the great loss that not only they, but also the whole of medicine, suffered by the death of Sir Thomas Lewis. Sir Thomas was the first person to be elected to a Beit Fellowship when they were instituted in 1910; and he was a member of the Advisory Board at the time of his death. The Trustees accepted with regret the resignation of Sir Henry Dale and Sir John Ledingham (who has since died) from the Advisory Board; Dr. C. H. Andrewes, Prof. J. H. Gaddum and Prof. H. Himsworth have been elected to fill the vacancies. They noted with pleasure the election this year of Dr. H. D. Kay (fellow 1922–28) and Miss M. Stephenson (fellow 1914 and 1920–22) to the fellowship of the Royal Society.

The following elections were made: *Fourth Year Fellowship (£500 a year)*: Dr. F. W. Landgrebe, to continue the study of the physiology of melanophore hormone and the nutritional factor responsible for the lethal effect of thiourea in rats (Materia Medica Department, Aberdeen). *Junior Fellowships* (£400 a year): Dr. J. F. A. McManus (Canada), to study the topography of lipine distribution in normal and pathological tissues (Department of Zoology and Comparative Anatomy, Oxford); and O. L. Thomas, to study thyroid activity, the pituitary phenomena found experimentally in thyroactivated animals, and the problem of neurosecretion (Anatomy Department, Oxford).

University of Durham: Appointments

MR. G. H. FORSYTH has been appointed to the chair of mechanical and marine engineering at King's College, Newcastle-upon-Tyne. Mr. Forsyth obtained first class honours in mechanical and marine engineering at the University in 1924, and in the following year proceeded to the degree of M.Sc. He was then employed for two years on research work with the North Eastern Marine Engineering Co., Ltd., and after a further period of three years spent at sea, he joined, in 1929, the staff of Lloyd's Register of Shipping, where he has been principal engineer surveyor since 1942. His published works chiefly concern investigations into causes of failure in marine engines.

Dr. David H. Valentine, University demonstrator and curator of the Herbarium and Museum at the Botany School, Cambridge, has been appointed to the readership in botany in the Durham Colleges. He was educated at Manchester Grammar School and St. John's College, Cambridge, where he held an open Major Scholarship in natural science. He took a first class in both parts of the Natural Sciences Tripos in 1932 and 1933, and was afterwards awarded a research grant and a studentship while working on induction phases in photosynthesis. In 1937 he was awarded the degree of Ph.D. for a thesis in plant physiology; and in 1938 he was elected a research fellow of St. John's College. During the War years he has been a temporary officer in the Ministry of Food, on work connected with vegetable dehydration, and visited Africa as the British technical member of the African Dehydration Mission. He has also done work, some of which is already published, on experimental taxonomy, with special reference to the British flora. In 1940 he was president of the Botanical Section and vice-president of the Cambridge Natural History Society.

Anglo-French Conference on Cosmic Rays

AN Anglo-French conference on cosmic rays v be held in the H. H. Wills Physical Laborato University of Bristol, during September 25–27, 19 It is hoped that some ten French delegates w attend, including Prof. P. Auger, Prof. F. Joliot a Prof. I. Curie-Joliot. Physicists in England wishi to attend are requested to send their names to Pr N. F. Mott, H. H. Wills Physical Laboratory, T University, Royal Fort, Bristol, 8. If accommod tion is required in Bristol, early notice should given; every effort will be made to arrange this, b it is hoped that visitors will make their own arrang ments where possible.

Copies of *Nature* for Service Men

LIEUT.-COLONEL J. P. CASTLE, of the Directora of Disposals, c/o British Embassy, Rome, A.P.C C.M.F., asks if a subscriber to *Nature* would be willi to forward him his copy of the journal when he h finished with it. After the headquarters' staff of tl Directorate of Disposals have read the journal, would be passed to the Y.M.C.A., Rome, for distrib tion through the Association's organization to tl troops. We suggest that any reader able to dispos of his copy of *Nature* regularly in this way shoul write direct to Lieut.-Colonel Castle. It may b recalled that the Services Central Book Depot make bulk issues of secondhand magazines; copies hande in to any post office are automatically forwarded t the Depot post free, without any address bein necessary. There are, however, no existing arrangements whereby copies of periodicals can be supplie to individuals through military sources.

Announcements

DR. O. R. GURNEY has been appointed Shillit reader in Assyriology in the University of Oxford a from October 1, 1945, or such later date as he i released from the Forces.

DR. MAURICE STACEY has been given the titl of reader in biological chemistry in respect of the post held by him in the Department of Chemistry, University of Birmingham.

AN offer to establish a trust fund, the capital o which at the end of seven years is expected to b about £10,000, has been received by the University of Cambridge from Mrs. A. M. Sims. The income of the fund would be used to endow a Sims Empire Scholarship for research in physics, chemistry, mathematics, medicine, or any other subject which may be selected from time to time.

ON August 5 the B.B.C. is presenting the first of a new fortnightly series of programmes entitled "Science Magazine". In the first broadcast, listeners will hear an outline of the series as a whole. The programme will be illustrated by excerpts from the recorded opinions of Prof. F. G. Donnan, Sir Robert Watson-Watt, Prof. I. M. Heilbron, Dr. E. Hindle, Sir Howard Florey, Prof. J. D. Bernal, and Dr. C. D. Darlington. This series can be heard on alternate Sundays in the Home Service at 7 p.m.; there will also be a recorded repeat on the following Friday, again in the Home Service, at 4.45 p.m.

ERRATUM.—Dr. D. H. Hey has been appointed to the University chair of chemistry tenable at King's College, London, and not at the Imperial College of Science and Technology as previously announced by the University (see *Nature*, July 28, p. 108).

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible or opinions expressed by their correspondents. No notice is taken of anonymous communications.

netration of Fast Nucleons into Heavy Atomic Nuclei

WITH the view of interpreting the disintegration ars' observed in photographic emulsion exposed to smic radiation, Heisenberg[1] developed a theory of e penetration of a fast nucleon into a heavy nucleus, sed on the idealization of nuclear matter as a de-nerate Fermi gas of nucleons, and on the assump-n that the interaction between these constituent rticles and the impinging nucleon can be repres-ted by a simple central potential. As a justification the latter assumption one may adduce the fact at the collision cross-section, computed by Born's ethod of approximation, quite generally tends to ro as the transfer of momentum in the collision creases. The energy distribution of the nucleons ocked out by the impinging fast particle, as given this theory, turns out to depend sensitively on the nge of the central potential, so that a comparison this energy distribution with observation should ad to a fairly accurate determination of this range. ich a comparison has actually been carried out by agge[2] and Ortner[3], under the assumption that the w of force is of the type $e^{-\kappa^2 r^2}$.

The result was very satisfactory, inasmuch as the nge value found in this way coincided, within the mits of empirical errors, with that deduced from e much more precise evidence furnished by proton-roton scattering experiments. The question natur-ly arises, whether the same check would also be uccessful for other laws of nuclear force, for which he range has been determined from the proton-roton scattering data, in particular for potentials of he 'well' and 'meson' types. It is the purpose of his letter to point out that Heisenberg's theory is nfortunately not applicable in its simple form to uclear potentials of those types.

This conclusion cannot be reached merely by nvestigating for such potentials the energy distribu-ion of the ejected nucleons, for one will always get definite answer to this problem for any law of orce. But the inadequacy of the theory becomes pparent when one calculates the mean energy loss f the impinging nucleon per unit of path in nuclear natter. This quantity has also been computed by Heisenberg for the case of the $e^{-\kappa^2 r^2}$ potential; and t is an easy matter, making use of a transformation f variables first proposed by Bagge[2], to extend the alculation to the case of a central nuclear inter-ction of the general form

$$\mathbf{V} = -\,\mathbf{J}.\mathbf{O}.w(\xi) \quad , \quad \xi \equiv \varkappa r, \qquad (1)$$

in which the operator **O** embodies the dependence on pin and isotopic variables and $w(\xi)$ the distance dependence (the parameter $\varkappa$ being a measure of the inverse of the range of force); the function $w(\xi)$ is normalized in such a way as to reduce either to ξ^{-1} or 1 for $\xi \rightarrow 0$, while the normalization of **O** is chosen so that its expectation value be unity in ${}^{13}S$ states of the pair of interacting nucleons: the constant **J** thus gives the 'strength' of the potential for such states. If ε denotes the energy of the impinging nucleon in units of Mc^2 and v the corresponding velocity, one finds for the rate of decrease of ε per unit of path

$$\frac{d\varepsilon}{ds} = -\,\frac{3}{2}\,\overline{\mathbf{O}^2}\,\mathbf{H}\,\frac{1}{\varkappa^2 r_0{}^3}\left(\frac{\mathbf{J}}{Mc^2}\right)^2\left(\frac{c}{v}\right)^2 \qquad (2)$$

In this formula, r_0 denotes the unit nuclear radius (the radius R of the nucleus of mass number A being $R = r_0 A^{1/3}$), $\overline{\mathbf{O}^2}$ is a suitable average of the operator $\mathbf{O}^2$ over spin and isotopic variables of the colliding nucleons (numerically $\simeq 0{\cdot}52$ according to the best data), and **H** is a constant characteristic of the law of nuclear force $w(\xi)$, defined by

$$\mathbf{H} = 2\int_0^\infty u^2\,\mathbf{F}^2(u)\,du, \quad . \quad . \quad . \quad . \quad . \qquad (3).$$

where

$$\mathbf{F}(u) = \frac{1}{u}\int_0^\infty w(\xi)\sin u\xi\;.\;\xi d\xi \qquad (4)$$

is essentially the Fourier integral coefficient of $w(\xi)$. It must be stressed that the same value is obtained for **H** whether one assumes the aforementioned Fermi distribution for the constituent particles of the knocked nucleus or treats these particles as being at rest and entirely independent of each other. This result is in conformity with a general property first enunciated by Williams[4], namely, that the mean energy loss per unit of path of a fast nucleon traversing a nucleus is independent of the mutual interactions and state of motion of the constituent particles of this nucleus.

However, the above formula (2) loses any meaning if the integral **H** does not converge. This eventuality will present itself, as shown by (3), as soon as $\mathbf{F}(u)$ does not decrease faster than u^{-2} for large u. In particular, it is immediately deduced from (4) that for the well type of potential: $w(\xi) = 1$ for $\xi \leqslant 1$, and $w(\xi) = 0$ for $\xi > 1$; and for the meson type $w(\xi) = e^{-\xi}/\xi$, **H** diverges logarithmically. [In the derivation of formula (2), the 'exchange' contribution to the collision cross-section was neglected. It is easily verified, however, that the inclusion of this effect does not prevent the divergence of **H**.] In these instances, the divergence can be traced to the occurrence of an infinite field intensity (either at the boundary of the well or at the centre of the meson field of force), as a result of which the probability for a momentum transfer p, being proportional to $[\mathbf{F}(p/\hbar\varkappa)]^2$, does not decrease sufficiently rapidly for large p.

In view of Williams's theorem, the breakdown of the theory in such cases can, of course, not be ascribed to the use of the Fermi gas model, nor is there any cogent reason to doubt the legitimacy of Born's approximation in calculating the collision cross-section. But the use of a central potential to describe nuclear interaction is no longer justified for momentum transfers $p \gtrsim Mc$: recourse should then be had to a relativistically invariant field theory of this interaction. While such a theory cannot at present be developed in a consistent way, it is possible to surmise its probable effect on the energy distribution of the ejected nucleons. Thus, if one compares the empirical energy distribution with that derived from the theory for a meson potential with a range of force corresponding (by Yukawa's relation) to the mass of the cosmic ray mesons ($\simeq 200$ electron masses), one finds that the theory predicts much too large a proportion of very fast ejected particles: since a more refined theory, using meson field interaction, would (if it is to remove the divergence of **H**) tend to diminish the cross-section for large momentum transfers, it may be expected that it would lead to a better agreement with observation.

L. ROSENFELD.

Instituut voor theoretische Natuurkunde,
Rijks-Universiteit, Utrecht.
May 5.

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[1] Heisenberg, W., *Leip. Ber.*, 89, 369 (1937).
[2] Bagge, E., *Ann. Phys.*, 35, 118 (1939).
[3] Ortner, G., *Wiener Ber.*, 149, 259 (1940).
[4] Williams, E. J., *Nature*, 142, 431 (1938).

A New Interference Effect

IN the course of a class experiment demonstrating the circular Haidinger fringes produced by monochromatic illumination of a thin film between silvered surfaces, it was noticed that coloured circular fringes could be seen if white light illumination was used. The effect is best seen by looking through the film (for example, a thin air film between silvered glass plates, or a thin mica film silvered on both sides) with the eye accommodated for infinity, at a strong point source such as a 'Pointolite'. For normal illumination, the point source is seen surrounded by several rainbow fringes, as in Fig. 1, while for oblique illumination, a sharp circular white-light fringe is seen passing through the source, with concentric rainbows inside and outside, as in Fig. 2. Unlike the usual monochromatic fringes, these fringes are not influenced by lack of accurate parallelism of the silvered surfaces. The sharpness of the white-light fringe improves with increase of the reflexion coefficient of the surfaces; with plates heavily silvered by the Tolansky technique[1], the fringe width is limited only by the size of the source.

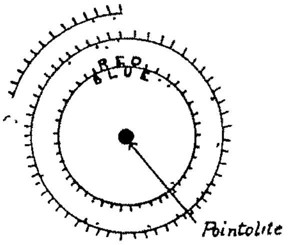

Fig. 1.

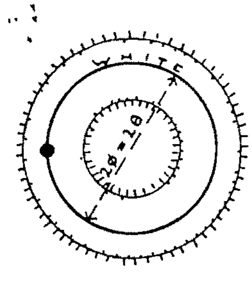

Fig. 2.

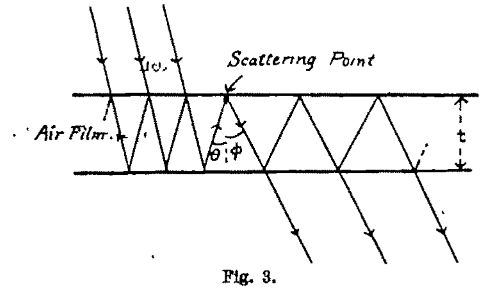

Fig. 3.

A similar effect in reflexion instead of transmission was first described by Newton and explained in detail by Stokes[2], who mentions that he tried unsuccessfully to observe the present effect in light transmitted through an unsilvered glass plate. We suggest the following explanation, similar essentially to that of Stokes. The fact that any illumination at all is visible off the line from the eye to the point source indicates that light is being scattered diffracted from small irregularities in the silve surfaces, and we suppose the fringes to be form by light which has been multiply reflected at angl then scattered, and again multiply reflected at an φ (see Fig. 3). In the first series of multiple reflexio light of wave-lengths for which

$$2t \cos \theta = m\lambda \quad (m \text{ integral}) \quad . \quad .$$

is strongly enhanced in transmission; while af scattering, light of wave-lengths for which

$$2t \cos \varphi = n\lambda \quad (n \text{ integral}) \quad . \quad .$$

is further strongly enhanced. If both (1) and are simultaneously satisfied, then we have

$$2t (\cos \theta - \cos \varphi) = (m - n)\lambda \quad . \quad . \quad .$$

Thus for a given value of θ and for $m = n$, all wav lengths for which (1) is satisfied will appear stron for $\theta = \varphi$, producing the white fringe. For $|m-n$ 1, 2, etc., these same wave-lengths will appear slightly varying angles φ given by (3), producing t various rainbows (each will appear to be practica continuous if m is fairly large). The mechanism in fact, similar to that of the production of whi light fringes by light passed through two thin fil of slightly different thicknesses (sometimes call Brewster fringes), except that in our case the seco path difference is introduced in the same film aft scattering.

It will be seen that the formula accounts quali tively for the facts described, and measurements fringe angular diameters, using an air film abo $40\lambda_{Na}$ thick, have confirmed it quantitatively. Accu ate parallelism is unnecessary since for $\theta =$ $(m - n) = 0$ for all values of t. Some further observ tions confirm this explanation: (*a*) If the silver surfaces are accurately parallel and the 'Pointolit is viewed against a background illuminated by sodiu light, the usual Haidinger sodium fringes may be see superimposed on the white-light fringes. It is the found that for certain values of θ (those satisfying (with $\lambda = \lambda_{Na}$) the system of sodium fringes coincid exactly with the white-light system. (*b*) If th 'Pointolite' is replaced by a point monochromat source (for example, a small aperture in front of sodium vapour lamp, with precautions to avoid a stray light), fringes are seen to appear in the usu positions of Haidinger fringes whenever θ satisfi (1) but are scarcely visible at other angles. (*c*) Clos examination of the white fringe shows that it is mad up mainly of bright spots; this supports the ide that scattering is from discrete irregularities in th silvered surfaces. It is perhaps significant that th silvered plates which best showed the effect had bee exposed to Manchester air for some days, which ma have increased the number of scattering centres this point, however, requires further investigatio

A more detailed treatment enables calculation o the intensity distribution in the white-light fring and explains the sharpening of the fringe with in crease of the reflexion coefficient of the silvered sur faces, just as in the case of monochromatic Haidinge fringes.

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June 1.

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Scaliness of Wool Fibres

According to a theory of milling which was developed some years ago, fabrics are capable of undergoing milling shrinkage only when some or all of the component fibres possess a surface scale structure, are easily deformed, and show perfect recovery from deformation[1]. It should, therefore, be possible to make wool unshrinkable by modifying its elastic properties instead of by the customary method of attacking the surface-scale structure. The truth of this deduction has been established in a number of ways[2,3,4]. Perhaps the most convincing is the recent demonstration that woollen flannel can be made unshrinkable by treatment with mercuric acetate or benzoquinone[4]. Both reagents increase the resistance of the fibres to deformation; both *increase* the scaliness of the fibres, as measured in soap solution by means of the lepidometer[5,6]. In the light of these results it was concluded that mercuric acetate and benzoquinone make wool unshrinkable by modifying the elastic properties of the fibres, and not by attacking or masking the surface-scale structure.

The scaliness measurements, on which the validity of the preceding conclusion depends, were carried out under conditions which reproduce the fibre-travel responsible for milling shrinkage: single fibres were suspended, root end downwards, from a tension-measuring device and rubbed longitudinally in soap solution between the rubber surfaces of the lepidometer. The maximum tension developed by the creeping fibre was taken as a measure of its scaliness. Precisely similar results are obtained when the scaliness of fibres treated with mercuric acetate or benzoquinone is measured by the older 'violin bow' method[7], which is, however, less satisfactory in being less closely related to milling conditions. It consists simply in determining the angle of tilt necessary to cause a 'bow' of fifty fibres to slide on a face cloth, first in the direction of the root end (θ_1) and then in the direction of the tip (θ_2), the scaliness (S) being defined as:

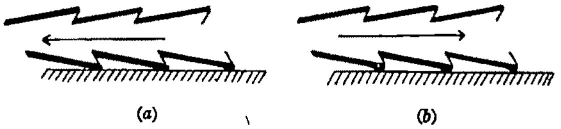
$$S = \frac{\tan \theta_2 - \tan \theta_1}{\tan \theta_1} \cdot 100.$$

The results obtained by this procedure are given below:

Treatment	Percentage shrinkage in area of fabric in milling	Scaliness of fibres in:	
		Air	Sodium oleate solution (0·2%)
Untreated	37·3	32·6	142
Mercuric acetate	4·4	31·2	182
Benzoquinone	20·2	31·4	>200

Thus, whether the scaliness is measured under static or dynamic conditions, whether it is measured on wool or rubber surfaces, the results indicate that the unshrinkability of fabric treated with mercuric acetate or benzoquinone is not due to reduced scaliness of the fibres.

The preceding results, like those given by the lepidometer, are in sharp contrast with those recently obtained by Bohm[8], and the most probable cause of the discrepancy is his use of a hard, inflexible surface —glass—for the friction measurements. Although Bohm's data are therefore of doubtful value in relation to the milling process, some explanation must be offered for his observation that the two coefficients of friction (towards the root and towards the tip) of fibres treated with mercuric acetate or benzoquinone are so nearly alike, whereas those of untreated fibres are far apart. A possible explanation is to be found in terms of Rudall's model[9], which was originally devised to explain why untreated fibres migrate when they are rubbed longitudinally between wet glass plates. A wooden ratchet was provided with rubber 'scales' as shown in the sketch. When the model was pushed towards the 'root' end on glass, the friction was less than when it was moved in the direction of the 'tip', owing to the different configurations adopted by the edges of the 'scales', as shown in (*a*) and (*b*), respectively. It is obvious that no such difference would arise on glass plates if the rubber were replaced by a more rigid material. Since cross-linking reactions increase the resistance of wool fibres to deformation, the differential frictional effect will be correspondingly reduced on glass, if the scales of the fibres behave in the same way as the 'scales' of the model. As has already been shown, however, the difference in friction would still be observable on flexible surfaces, and it seems likely that Bohm's observations are a measure of the effect of mercuric acetate and benzoquinone in modifying the elastic properties of the fibres.



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May 26.

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Mechanism of the Feulgen Reaction

The Schiff reaction for aldehydes using the addition compound of sulphurous acid with fuchsine was applied by Feulgen for his well-known reaction for the localization of desoxyribosenucleic acid in cells. The specificity of this localization in the reaction has recently been questioned[1], and led to the series of investigations to be described, from which it is concluded that the reaction is essentially one of adsorption, and that nucleic acid is not necessarily concerned in the reaction. Normal, malignant and embryonic tissues of mouse, fowl and normal rabbit tissues, fixed by various methods, were used in the staining tests.

(1) *Colour of the stain.* It can readily be shown that though neutral fuchsine stains filter paper or sections bright red, the typical mauve colour is produced if the dye is used in weakly acid solution, as in the usual Feulgen method. Though the colour is washed out of filter paper by sulphur dioxide water, it is not removed completely from other materials such as newsprint, poor quality cotton wool, or alumina. Furthermore, a section stained bright red by neutral dye will show the typical Feulgen colour if dipped

into acid buffer solution. The colour does not therefore indicate anything about the nature of the material.

(2) *Hydrolysis.* In the Feulgen reaction the tissue is placed in $N/1$ hydrochloric acid for a few moments 'to hydrolyse the nucleic acid'. But acid is known to destroy much of the cytoplasm[2], though the nucleus remains intact for a longer time in the same circumstances. The method is, in fact, used to prepare free nuclei for analysis. An examination of finely minced tissues subjected to such treatment for varying intervals will leave no doubt that very extensive destruction of the cytoplasm occurs during hydrolysis, and will suggest that the localization of the stain in the nucleus in the Feulgen reaction may well be due to the fact that only a ghost of the cytoplasm is left after hydrolysis. Before hydrolysis both the cytoplasm and nucleus of a section stain mauve with acidified fuchsine, but after hydrolysis only the nucleus takes the stain; the appearance is then exactly the same as that of a normal Feulgen stain for such tissue.

(3) *Staining of chromosomes.* The Schiff reaction is carried out in solution. When a solid phase is present, as in the Feulgen reaction, complications due to adsorption may occur. If an adsorbing material is present which will disrupt the sulphurous acid–fuchsine compound by having a stronger attraction for the dye than the sulphurous acid, the mauve colour will reappear. This can be shown in a test-tube reaction by adding alumina to Schiff reagent, when the dye (in the coloured form) is adsorbed on the solid, even in the presence of a large excess of sulphur dioxide. As it is well known that chromosomes will adsorb and concentrate dye from a weak solution, this effect cannot be disregarded in the Feulgen reaction. In fact, the varying distribution of the Feulgen stain in chromosomes with heterochromatic regions is equally well shown by certain simple stains such as crystal violet, where only differential adsorption need be considered.

The degree to which adsorption acts in the Feulgen reaction can be found by adding a large excess of sulphur dioxide to the Feulgen stain, and staining as usual. Thus in one experiment there was more than forty times the wet weight of the section of sulphur dioxide in excess; even if the section were all nucleic acid, there was not enough to act with the sulphur dioxide present to liberate any colour. Nevertheless, a perfectly normal 'Feulgen reaction' was obtained. Similarly, if the section is pretreated with sulphur dioxide water before immersing in the stain, this sulphur dioxide will react with all the desoxyribose, and thus no further reaction can be expected when the section is placed in the decolorized fuchsine solution. In spite of the fact that no dye can thus be liberated by chemical reaction, here again a perfectly normal 'Feulgen reaction' results.

It seems clear, therefore, that neither the presence nor the location of the stain bears any relation to the presence or absence of either of the two nucleic acids, but can be merely a reflexion of the adsorbing power of the chromosomes. It should be noted that the adsorbing reactivity is only developed after hydrolysis. This different adsorbing power, with which is associated differences in the biological activities of the parts of the chromosomes, cannot therefore be proved to be due to differences in nucleic acid concentrations or different varieties of nucleic acid (ribose or desoxyribose types) by the use of the Feulgen reaction. For the demonstration of these adsorption differences in the chromosomes the use of acidified fuchsine on acid-digested material is more convenient than the complications of the Feulgen reaction using decolorized fuchsine.

All expenses in connexion with this work were borne by the British Empire Cancer Campaign.

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[2] Stedman, E., *Edin. Med. J.*, 51, 343 (1944).

Viridin: a Highly Fungistatic Substance Produced by *Trichoderma viride*

The mould *Trichoderma viride* Pers. ex Fries is generally known to possess marked powers of antagonism to other fungi. It has been previously shown[1] that some strains of this mould produce gliotoxin. We have recently found a number of strains which produce another substance, which we propose to name 'viridin', characterized by remarkably high fungistatic activity.

Our viridin-producing strains of *T. viride* are characterized by the rapid production of a bright yellow colour in the culture medium, particularly in media containing nitrate, such as Czapek-Dox. In our experience, gliotoxin-producing strains of *T. viride* do not produce this pigment. We have found that if suitable pigmented strains are grown on thin layers of Weindling[2] or Raulin-Thom medium, for four to six days at 25° C., the culture medium develops high fungistatic activity and may be diluted 2,000 times or more and still inhibit the germination of conidia of *Botrytis allii* Munn. The active material (viridin) has been isolated from such culture filtrates by extraction with chloroform, evaporation to dryness under reduced pressure, followed by crystallization from ethyl alcohol.

The viridin thus produced appears as colourless rod-like prisms, which decompose without melting at 217–223° C.; yields of the order of 45 mgm. per litre of culture filtrate have been obtained. The crystals contain no nitrogen, sulphur or halogens and give no ash on combustion. Analyses are given in Table 1.

Table 1.

%	Found	$C_{20}H_{16}O_6$ requires
C	68·3	68·2
H	4·7	4·6
OCH_3	8·9	8·8 (for one OCH_3)
Active H (Zerewitinoff)	0·5	0·6 (for two H)
CH_3 attached to C	3·5	4·3 (for one CH_3)
Molecular weight (depression of f.p. of bromoform)	331	352·2

Viridin is almost insoluble in ether and camphor and gives no coloration with alcoholic ferric chloride. It is optically active; for a 1 per cent solution in chloroform, $[\alpha]_D^{18}$ is $-$ 222°.

The addition of phloroglucinol and hydrochloric acid to a very dilute alcoholic solution of viridin gives a deep reddish-violet colour. This colour resembles that given by lignin with this reagent, and indeed we were prompted to try this reaction by a similarity between the properties of lignin and a substance tained from viridin by reduction. By means of is test with phloroglucinol and hydrochloric acid, ridin may be distinguished from gliotoxin, which ves no colour.

TABLE 2.

Substance	Least concentration (μgm./ml.) preventing germination of *Botrytis allii* conidia
Viridin	0·005
Gliotoxin	3·0
Mercuric chloride	0·5
Di(ethylmercuri) hydrogen phosphate	0·025

Aqueous solutions of viridin at *p*H 3·5 prevent the rmination of *B. allii* conidia at concentrations of e order of 0·005 μgm./ml. Results of a comparison ith several known fungicides are given in Table 2. his high sensitivity to viridin is not confined to . *allii*; *Fusarium* spp., *Trichothecium roseum* and *ephalosporium* spp. have shown the same order of nsitivity, but a number of species of *Penicillium* nd *Aspergillus* require concentrations of 3–6 μgm./ml. prevent germination. iridin does not appear be markedly bacterioatic.

Aqueous solutions of virlin are unstable, except t low *p*H. At *p*H 6·5, the ctivity of a 100 μgm./ml. olution is almost comletely lost in one day, t *p*H 7·5 activity is lost nstantaneously, but soluions at *p*H 3·5 are relaively stable. Gliotoxin hows a similar intolernce of high *p*H, but is ore stable than viridin.

Some progress has been made towards the elucidation of the constitution f viridin. Work on its chemical and biological roperties is being continued and our results will e reported in greater detail elsewhere.

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[1] Brian, P. W., *Nature*, **154**, 667 (1944).

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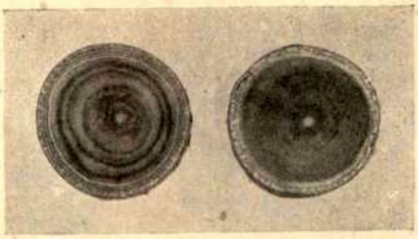
Abnormal Lignification in the Wood of some Apple Trees

FOR some years past, a condition generally referred to as 'rubbery wood' has been observed in many Lord Lambourne apple trees. A characteristic feature of this 'rubbery wood' is the flexibility of the affected shoots and branches, which allows them to be bent much farther than normal shoots before breaking, just as if they were composed of rubbery material. The affected branches usually taper very rapidly from base to tip. The cause of the trouble has not yet been established, but suggestions as to its origin have been put forward by several workers[1,2,3].



(*a*) (*b*)
Fig. 1. MILLER'S SEEDLING. TRANSVERSE SECTIONS OF (*a*) NORMAL BRANCH; (*b*) 'RUBBERY' BRANCH. NAT. SIZE.

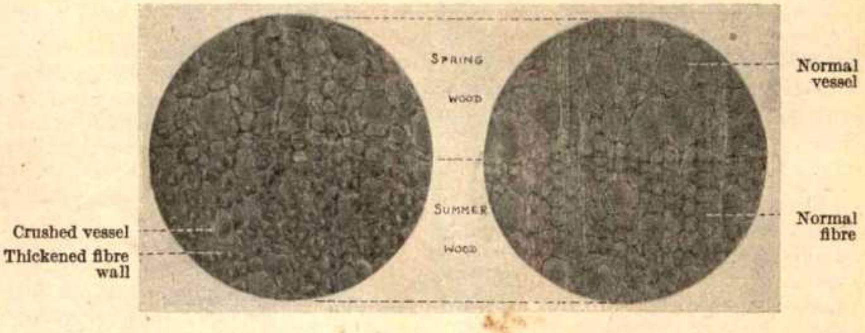


Fig. 2. LORD LAMBOURNE. STRUCTURE OF (*a*) 'RUBBERY' WOOD; (*b*) NORMAL WOOD. × 180.

Histological investigations carried out at East Malling Research Station have shown that the flexibility of the stems is associated with a lack of lignification of many of the xylem fibres and vessels. Lignification appeared to be normal in one-year old lateral shoots from 'rubbery' branches, except for occasional small areas near the cambium. In older shoots, and in the main stems of one-year old trees, most of the summer wood was unlignified, the spring wood alone giving the usual reactions to lignin stains; but even the spring wood was found to be unlignified in some very severely affected shoots more than two years old. This lack of lignification can be seen by the naked eye when a cross-section of the wood from a living branch is suitably stained, for example, with a 0·5 per cent solution of phloroglucinol in concentrated hydrochloric acid. The pale unstained areas of unlignified tissue contrast with the red-stained normal wood; the phloem and pericycle fibres were normally lignified in all the affected specimens (Fig. 1).

In the unlignified areas the walls of the vessels and fibres gave the usual staining reactions of cellulose. The vessels had irregularly shaped walls and some had collapsed altogether (Fig. 2). The xylem fibres were more or less circular as seen in transverse section, with abnormally thick walls surrounding a very small central cavity. In general appearance they resembled the description of the gelatinous fibres of tension wood[4]. Their distribution within the stem was, however, different, since the bands of gelatinous fibres in tension wood have seldom been observed to pass round the whole stem, whereas in 'rubbery' wood they often did so.

A similar lack of lignification has recently been observed in 'rubbery' branches from trees of the apple varieties, Miller's Seedling, Dartmouth Crab and James Grieve. The affected plants of the first two varieties were growing near trees of Lord Lambourne known to be 'rubbery'.

In conclusion, we should like to thank Dr. T. Swarbrick (Long Ashton Research Station), Mr. G. M. Stuart (East of Scotland Agricultural College), and Messrs. Chandler and Dunn (Canterbury), who kindly provided some of the specimens.

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[2] Crane, M. B., *Grower*, **22**, (53), 10 (1944).

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Pressure Units

THE recent communication by Dr. W. R. G. Atkins[1] directs attention to a considerable amount of confusion which still exists in statements of numerical results and constants. I suggest that one major change which is desirable is to adopt the bar as the unit of pressure in place of the millimetre of mercury.

In favour of this proposal the following considerations may be advanced: (1) The bar is an absolute unit (10^6 dyne cm.$^{-2}$). (2) The unit is already in use, and this use appears to be extending; for example, meteorological readings are expressed in millibars, intensity of sound in dyne cm.$^{-2}$, compressibility in bar^{-1}. (3) In calculations it is often necessary to work in C.G.S. units, involving the conversion of mercury units; for example, in measurements of surface tension or viscosity by methods which involve readings of pressure, and in thermodynamics. (4) The statement of results in terms of the bar avoids the possibility of some degree of indefiniteness when temperature and latitude are not stated, and simplifies statements by removing the necessity for specifying such conditions. (5) The present time presents probably the most favourable opportunity for making such a change, as a large number of new text-books, and revisions of older works, may be expected shortly. (The proposal would fit in with the suggestion made by F. H. Townsend[2] for a new system of high-vacuum units, which could be based on the millibar.)

Against the proposal are the following points. (1) Measurements of pressure are often (but not always) made by means of manometric pressure gauges. (2) A large number of physical and chemical constants are already calculated in terms of mercury pressure.

In answer to the first objection it may be suggested that as, for accurate work, it is necessary in any event to correct for temperature and gravity, no extra labour is involved, since the product of the density of the manometric fluid at a standard temperature and g would be a constant of the apparatus. It would appear to be as easy for an apparatus maker to graduate a mercury gauge in millibars as in millimetres.

With regard to the second point, the constants concerned include: (*a*) A comparatively small number of important constants, such as the gas constant for particular gases, and related constants, which could be converted very simply; for example, the volume per mol. of a perfect gas becomes 22,712 c.c. at one bar, instead of 22,415 c.c. at 760 mm. (*b*) A larger number of readings of vapour pressures, etc., where the measured constant is itself a pressure. Pressures given in reference tables would have to be converted to millibars, etc., and this labour migh present the chief obstacle to the adoption of th proposal. (*c*) A very large number of constant including the International Temperature Scale an tables of boiling-points, the values of which depen on pressure and are given for a specified pressure In most cases there is no need to recalculate thes quantities immediately—they can be quoted fo 1·01323 bar instead of for "760 mm. Hg at 0° C and lat. 45°."

Finally, for approximate conversion from units o mercury pressure to absolute units, it may be note that 1 bar is equivalent to 750·08 mm. of mercury (approx. 75 cm.—a point which may interest thos who teach elementary science).

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The 'Green Flash' at Sunset with a near 'Horizon'

IT is frequently assumed that the phenomenon o the 'green flash' can be observed only when the sun is seen to rise, or to set behind a distant land- or sea-horizon. That such is not the case, the following report of a recent naked-eye observation will confirm.

At 20h. 12m. U.T. on June 20, 1945, I observed the sun setting behind the horizontal roof-line of a building distant approximately 440 yards from the site of observation. Immediately prior to the disappearance of the last remaining segment of the sun's limb, its colour was seen to change from light orange-yellow, through yellowish-green, to a distinct, but pale, green. At the instant of disappearance I observed the rapidly diminishing bead of sunlight to assume a just perceptible blue-green hue. On account of the large parallax introduced by the short distance from the artificial horizon, it was possible to repeat the observation by standing on tiptoe. The complete sequence of colour changes occurred in a time interval estimated to last from one quarter to one half of one second. It was noted that each of the transient colours was markedly less saturated than those which I had observed against a distant land-horizon on several occasions during the summer of 1940 from the summit of Mount Hamilton, California.

A rough estimate indicated that the altitude of the terrestrial obstacle was rather less than one degree above the true horizon on a bearing due north-west. On the evening in question there was a light southerly wind with a cloud cover of 2/10–3/10 *Ci*, the sky in the direction of the sun being entirely free from cloud. Horizontal visibility was excellent; I estimated the range to be in excess of ten miles.

Using an opera-glass to screen off unwanted light, Whitmell[1] has reported an observation of the green flash with the 'horizon' distant only 300 yards, but I have not been successful in finding any reference to naked-eye observations over so short a range as that recorded in the present note.

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VISCOSITY OF LIQUIDS AND COLLOIDAL SOLUTIONS

1940 there was held in Moscow, under the auspices of the Academy of Sciences, a conference on riction and Wear in Machinery". At this confere it was decided to hold a further conference, in following year, on "Viscosity of Liquids and loidal Solutions". This took place just before the rman invasion and only a part of the proceedings e volume) was published before the serious events the first months of war made further publication porarily impossible. The second volume finally peared in a war-time format, in 1944 (Moscow d Leningrad: Academy of Sciences, 1941 and 44).

The subject-matter is divided into four separate tions: (1) theory of viscosity of liquids; (2) cosity of greases; (3) viscosity of molten materials high temperatures; (4) viscosity of colloidal utions. The first section is under the general torship of Prof. B. V. Deryagin, the second of of. D. S. Velikovskiĭ and the third and fourth of of. M. P. Volarovich, who is already well known to itish rheologists through his papers in the *Kolloid itschrift* dealing with an extremely wide range of terials. The two volumes contain more than enty papers in Russian; there are no summaries other languages.

Typically, there was no divorce between theory d practice at the conference. Some of the papers highly theoretical, with an advanced matheatical approach: others describe experimental idies on practical problems of immediate importce in industry.

Frenkel'[1] provides two papers showing the relationip between current theories of liquid structure. ere is also a short general note by Bachinskiĭ. irokov studies viscosity (η) as a wave phenomenon d deals with the theoretical aspects of heat conictivity. He also discusses the phenomenon of perfluidity, on which Kapitza provides an experiental paper on liquid helium; and Landau, a short scussion on quantum lines.

A theoretical study of the effect of magnetic and ectric fields on the viscosity of anisotropic liquids d molecular orientation is given by Tsvetkov; d Chernyuk has extended the work of Sokolov and sinskiĭ[1] on the influence of static fields on the scosity of organic liquids. In almost all the materls studied, there is an increase in viscosity with creasing field strength. Dombrovskiĭ shows marked creases in viscosity over a wide temperature range a result of sound-wave and ultrasonic radiation. the case of oils, Panchenkov increases viscosity y radiation with 'ultra-short' electromagnetic diation and by electrode-less high-frequency disharge. The chemical factors concerned are discussed d precautions are described to prevent overheating sulting in cracking of the oil.

The temperature- and pressure-coefficients of vissity are dealt with by a number of authors. Kobeko, uvshinskiĭ and Shishkin give $\log \eta / \frac{1}{T}$ curves for ther, alcohols and glycerine and many salt solutions T is absolute temperature). On the whole, they onclude that existing theory is inadequate and that n entirely new theory of liquid structure is required. amaya gets remarkably good linearity plotting temperature- against pressure-coefficients for lubricating oils.

Liquid mixture laws are dealt with by many authors. Luchinskiĭ develops an extension of the Bachinskiĭ equation which proves satisfactory for chloroform-benzol and sulphuric acid-toluol mixtures. Frenkel' discusses the general theory, and Voskresenskaya, Ravich and Shternina its application to physicochemical analysis. Udovenko distinguishes 'rational' and 'irrational' systems. For the former, isotherms can be resolved into two hyperbolic curves: for the latter the log η/temperature curve for the mixture shows no correlation with those of the components. Usanovich stresses the advantages of differentiating S-shaped mixture-curves, thus obtaining curves with simple maxima.

Single-figure expressions for viscosity-temperature coefficients of oils are badly needed. The 'viscosity index' comes in for considerable criticism, especially from Peĭsakhodina, Shne'erova and Tarmanyan working at low temperatures. Velikovskiĭ discusses the use of the Walther equation. There is also a useful technological paper by Zherdeva, Vozzhinskaya and Fedose'eva. The history of the $\log \eta / \frac{1}{T}$ equation is given very fully by Volarovich in a general survey of the theory of liquid structure.

On the instrumental side, Volarovich provides a survey of viscometers for petroleum products, with an excellent bibliography of papers from many countries. It appears that Soviet workers are more familiar with British and American work than British men of science are with the Russian; and the need for a wider knowledge of the Russian language among British rheologists is here strongly evident. Golenev gives comparative data for viscometers of the Ostwald and Engler types, and Shvidkovskiĭ develops further the earlier analyses of Andrade and Chiong[2] and Andrade and Rotherham[3] on the Meyer viscometer[4], a hollow cylinder containing liquid, hung on a torsion wire. A capillary viscometer suitable for oil and the choice of oil viscosity standards are discussed by Pinkevich. Deryagin and Samygin measure the viscosity of polymolecular films of liquids by observing the movement of air bubbles in the annular space between concentric sealed tubes under varying intensities of centrifugal force. There are three papers by Trapeznikov on monolayer viscosity, one of which shows complex curves relating η to stress and log η to temperature for high alcohols. Limar' describes an apparatus to measure the pumping properties of oil and discusses the relation between these and viscosity; and Ramaya regards the viscosity of oil containing added substances as analytically composed of two parts, a Newtonian and a thixotropic component.

The second section, on grease, contains a number of excellent papers. Greases are such complex systems that it is hard to find any single factor to describe consistency even for comparative industrial purposes. The work of Arveson[5] and of Blott and Samuel[6] is widely quoted. Varentsov uses the Scott Blair[7] emptying tube viscometer. He plots the wall stress against $4/RT$ where R is radius and T is the time taken for the meniscus to pass unit length of the tube. This is simpler than the usual method of plotting, which involves the difference in the squares of the initial length of the column and that at the time in question. Even plotting log-log gives complex curves, and the use of the method is restricted to low pressures and for comparative purposes. Velikovskiĭ uses the same method. He prefers to designate the consistency of grease by its 'mechanical equivalent', that is, the viscosity of an oil which requires the same force to produce an equal rate of flow under arbitrarily fixed conditions. Varentsov also calculates a shear modulus (γ) from Philippoff's[8] modification of the Eisenschitz formula:

$$\eta' = \eta_\infty + \frac{\eta_0 - \eta_\infty}{1 + \frac{2}{3} \cdot \frac{P^2}{\gamma^2}}$$

where η' is observed viscosity; η_0 and η_∞ are limiting viscosities at low and high shear rates; P is pressure.

There are also a number of useful technological papers on the rheology of greases. Rebinder, Boguslavskaya and Moki'evskiĭ find that the yield-value is independent of capillary radius which serves as a useful criterion of consistency.

There has been considerable discussion between British and American rheologists on the nomenclature of consistency of non-Newtonian systems. Velikovskiĭ proposes to use the term 'internal friction' (*Vnutrene'e treni'e*) to describe the ratio of shear stress to rate of shear when this is not independent of stress or shear rate, but the symbol η is used for both this and (constant) viscosity.

The section on molten lavas, melts and slags is perhaps rather less interesting, the data consisting mainly of viscosity-temperature curves with little theoretical comment. Exceptions are papers by Volarovich, who discusses the relative merits of various viscometers for molten metals and silicates; Kozakevich, Leĭba and Komar' (binary and ternary mixtures of FeO, CaO and SiO_2); and Semik, who studies the effect of addition of bases on the anomalous viscosity of surface layers of steel foundry slags. There are four good papers on the viscometry (mainly rotational instruments) of molten glasses: Fromberg, Tsyplënkova and Rabinovich; Oshchipkov and Rabinovich; Solomin; and Kumanin, Fizhenko and Zelichënok.

In the colloid section, there are two excellent papers on theoretical rheology by Finkel'shteĭn and Chursin, and by Rebinder; the former deals with extensions to the Einstein equation and the latter relates colloidal structure to types of flow curves. On the technological side, Branopol'skaya has a good paper on the rotation-viscometry of flour doughs, and Ravich gets a linear relation between η of high fatty acids and iodine number. There are also papers on the rheology of high polymers (Kargin and Slonimskiĭ), casein (D'yachenko), bitumens (Korotkevich) and coal tars (Kustov and Khotuntsëv). Kulakov is already known to rheologists interested in peat, and he contributes a paper on the relative merits of capillary, rotation and ball viscometers for this material. The first two methods are preferred to the ball. Serb-Serbina and Baranov have articles on the influence of electrolytes on the viscosity of clay suspensions.

In so brief a survey, one can do no more than sketch in the outlines of the contents of these books: many papers cannot even be mentioned. It is a pity that the whole proceedings cannot be translated into English. The conference undoubtedly marked a milestone in the progress of rheology, and it is to be hoped that when the War ends, language difficulties will not hinder a closer co-operation and understanding between British, American and Sovi rheologists as well as workers in the smaller countri

G. W. Scott Blair.

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[5] Arveson, M. H., *Ind. Eng. Chem.*, 24, 71 (1932).

[6] Blott, J. F. T., and Samuel, D. L., *Ind. Eng. Chem.*, 32, 68 (194

[7] Scott Blair, G. W., *Koll. Z.*, 78, 19 (1937).

[8] Philippoff, W., *Koll. Z.*, 71, 1 (1935).

HEALTH RESEARCH IN INDUSTR

THE health of the industrial worker has recent been the subject of a number of articles in t medical Press, and various aspects of it have be also discussed by medical societies. Attention h been directed to it by the endowment by the Nuffie Foundation of three university departments of indu trial health; and the national importance of th field of study is further emphasized by the issue th year of two important publications. These are t second interim report of the Social and Preventiv Committee of the Royal College of Physicians London and the Medical Research Council's public tion entitled "Health Research in Industry", whic records the proceedings of a conference on industri health held at the London School of Tropical Medicin during September 1944.

The report of the Committee of the Royal Colleg of Physicians is part of this Committee's study social and preventive medicine. Its first interi report dealt with the applications of this study i the hospital. This second interim report is the firs step in the study of social medicine outside th hospital. As the *British Medical Journal* (194 Feb. 10, 1945) points out, this report fills a ver obvious gap, because the Government's White Pape on national health does no more than state th present position of industrial health and does that i no more than one short paragraph and an appendix If, says this second interim report of the Roya College of Physicians, the Government's plans for th establishment of a sense of social security are t succeed, industrial production must be efficient; an efficient production requires contented workers, an they cannot be contented unless they are physicall and mentally fit. A third of the working years o most workers is spent in the places where they work and their working and home life affect each other s profoundly that each individual's whole life must b considered.

This Committee prefaces its recommendations by a useful outline of the development of British industrial medicine. Existing industrial medical services apply only to a small proportion of industrial workers at their places of work. It is in the smaller factories that it is usually difficult to maintain good working conditions. Factory inspectors, both lay and medical, have done magnificent work, but four hundred inspectors (including the sixteen medical ones) and the two hundred whole-time and seven hundred part-time works doctors cannot adequately supervise th health of the 250,000 establishments covered by th Factories Act of 1937. The Factories Acts do no ply to many industries and to others only certain tions of them apply. Some large businesses and me transport services (for example, railways and cks) have their own works doctors; but medical vices are most deficient outside factories where ey are needed most. Existing services are not equately co-ordinated. Control is shared by the ome Office and Ministry of Labour, while the nistries of Supply and of Fuel and Power have eir own independent medical services, and other w Ministries may create theirs. A national comehensive industrial medical service is required; it ould be organized on a regional basis as an essential rt of the national health service, with ultimate sponsibility vested in the Ministry of Health, hough certain administrative and executive funcons would no doubt have to be allocated to the inistry of Labour and National Service, the Minisies of Fuel and Power and of War Transport and e General Post Office. The Committee hopes that e Government will not adhere to its temporary clusion of industry from its national health heme, which lays a just emphasis on the family as unit for medical care and extends medical care to e home as well as to the place of work.

Everyone will agree with this Committee's strong ea for much better medical care for smaller industies, such as hotels, restaurants, shops, offices, the ilding trade and agriculture; and for recognition the fact that occupational disability and disease use only a fraction of the total illness of the workers, ho lose about fifteen times as many working hours the result of non-industrial sickness and accident they lose from industrial causes of disability; is estimate excludes, moreover, the considerable fects of subnormal health. Much preventable isease is due to factors operating outside the place work, such as bad housing, economic stress and ck of health education. Continuous medical investiation is necessary and the co-operation of the anagement is important. Rehabilitation, which has gured largely in the medical Press recently, is mphasized by this Committee, which strongly suport the Government's White Paper on Workmen's ompensation (Cmd. 6551), which would do much to stablish rehabilitation as part of the national health heme.

In its discussion of the planning of the education f medical men for industrial health work the Comittee refers to its first interim report, repeating that he medical student is not expected to become an xpert on occupational diseases, but should undertand the social problems involved and should ecognize the effects of fatigue, overwork, monotony nd other factors causing ill-health in industry; he hould therefore visit factories and should have good nd bad working conditions demonstrated to him. ere the reader of this report is reminded of the oodenough Report on Medical Schools (*Nature*, **154**, 15 and 322, Sept. 9, 1944). The family doctor hould, the Committee of the Royal College of hysicians thinks, be trained as a part-time industrial edical officer, and periodical refresher courses on his subject should be available for him. More xtensive training is planned for whole-time indusrial medical officers; this should not be too specialzed and should not be taken until two years after raduation and after one year of general practice. onsultants and specialists should be subject to the riteria for the recognition of consultants and pecialists laid down by the three Royal Colleges.

The section on research with which this report concludes links it with the Medical Research Council's publication mentioned above, which outlines the development of the Industrial Health Research Board of the Medical Research Council. The Committee of the Royal College of Physicians commends the work of this Board and its parent organizations and wishes that work to continue. The Board should, this Committee thinks, tackle problems of national significance and also problems which cannot be undertaken by other research organizations. Fundamental research should not be neglected; it should be done by the university departments of industrial health which are now being created, and these should correlate their work with that of the Industrial Health Research Board and with that of the local factory department. Co-ordinated with all these there should be, in each local administrative area set up under the national health scheme, a division for field investigation.

The work of the Industrial Health Research Board was reviewed at the conference mentioned above by Sir Edward Mellanby, secretary of the Medical Research Council. Sir Edward commended another review of it by Dr. Schelling in the *British Journal of Industrial Medicine* (1, 145; 1944). Reconstituted in 1942 by the Medical Research Council, the Industrial Health Research Board was given the study of the whole field of industrial medicine and disease, and it is expected that it will act in an advisory capacity in relation to all the problems being studied by the Medical Research Council itself. The Medical Research Council has organized much work on industrial health. During the War much research has been done for all the Fighting Services, and many of the principles learned during this work can be applied to industry. As examples of this application Sir Edward referred to the work done on blood transfusion, on traumatic shock, and on the problem of fitting men to the machines which they have to use and of fitting the machines to the workers.

The problem of recording causes of sickness absence in industry is fundamentally important. The Industrial Health Research Board's Report No. 85 (1944) deals with this problem, while Report No. 86 (1945) records a study of certified sickness absence among women in industry. Certified sickness absence for two or more days was studied in five munition factories, but uncertified sickness absence, which may or may not be genuine, was excluded. Other reports on this subject are to follow and they will include the views of the workers themselves. Other problems being studied are night work, atmospheric pollution in filling factories, new methods of sampling T.N.T., the efficiency of dust-sampling instruments, lighting problems and the incidence of psychoneurosis. Another example of the work of the Medical Research Council which has valuable applications to industry is the valuable report recently issued on the treatment of burns and scalds (Med. Res. Council Spec. Rep. Ser., No. 249, 1944. H.M. Stationery Office, 4*s.* net). This work records the conclusions drawn from observations made during recent years by the Medical Research Council's Burns Unit working at Glasgow Royal Infirmary. Another unit is working at Birmingham on infections to which injured industrial workers are liable.

The work of the Department for Research on Industrial Medicine, which was set up at the London Hospital by the Medical Research Council, was described to the conference by its director, Dr. Donald Hunter, who also edits the *British Journal of*

Industrial Medicine. An article by Dr. Hunter on industrial poisons was reviewed in *Nature* of April 1, 1944, p. 412; but Dr. Hunter pointed out that industrial poisons form only a relatively small part of the field of industrial medicine. His department is also studying the effects of inhalation of asbestos and other dusts, the 'dead hand' from which users of pneumatic tools often suffer and the effects of some of the appalling industrial noises, such as that which has made generations of boiler-makers deaf. Dr. Hunter also discussed rehabilitation, pointing out that many jobs can be done by men with chronic disease of the heart, lungs and nervous system and quoting Henry Ford's remark that there are more jobs in industry for men with one arm than for men with two.

The views of enlightened managers were given to the conference by Lord Forrester, managing director of the Enfield Cable Works, Ltd., and a distinguished worker in industrial and social fields, who emphasized the importance of a healthy environment for the workers and of a right integration of industry with the community to which it belongs. Research into management and the teaching of management are also required. Research teams composed of young men are essential and Lord Forrester suggested problems for them. One of these is the problem of posture in industry. The position of the operator is considered in the construction of tanks and aeroplanes, but surprisingly little attention has been given to it in industry. In the discussion which followed Lord Forrester's address, Sir Wilfrid Garrett, chief inspector of factories, told the conference that a committee has recently been appointed to study this problem. Lord Forrester thought that we need a better system of keeping industrial health records. We should abandon all systems of calculating working time in hours per day or week; we should think in terms of at least a year. Shift work is another problem requiring study; the worker should have the right kind of food, and time and leisure to eat it in suitable surroundings. Sanitation and hygiene are of high significance; yet the very important question of lavatory design is almost universally ignored. The town planner, the industrialist and the industrial health expert must get together to study the problem of the environment of industry itself. The smoking chimney and similar sins must go. Loss of green sward has important effects on the health of the people. Industry need no longer disfigure the land, or pollute its atmosphere and rivers; nor need its physical appearance be an abomination.

The point of view of the trades unions was put to the conference by Mr. G. A. Isaacs, general secretary of the National Society of Operative Printers and Assistants and president of the Printing and Kindred Trades Federation, chairman of the Workmen's Compensation and Factories Committee of the Trades Union Congress, and a member of the Royal Commission on Workmen's Compensation. He pointed out that the trades unions have studied industrial health for many years and gave examples of the improvements which they have achieved by their own efforts. He did not wish it to be thought that he was complaining about the work of the Home Office and Factory Department of the Ministry of Labour, which had, he insisted, done good work and had often acted when the Trades Union Congress had little information; but they had not the complete research organization which the trades unions considered essential. Research should have ample mon staff and equipment. Eradication of industrial hea risks was required, not mere recognition of and co pensation for them. Prompt, accurate and scient decisions were required as to what were and wh were not occupational diseases; such decisi should not be subject to argument in a court of la The worry caused to workers by industrial injur had been revealed in conferences called by the tra unions. Workers would always willingly help resear Mr. Isaacs suggested that more work was needed the effects of industrial fumes and dusts, on ventilat and lighting, on the effects of monotony, fatigue noise and on the risks of welding. He stressed, Lord Forrester also did, the need for communicat the results of research to the workers themselve language which they could understand.

At the final session of this conference Dr. K. J. Craik described the work of the Cambridge Unit Applied Psychology, of which he was direc until his untimely death on May 7. This Unit been studying problems arising from the needs the Services, but some of the principles learn during this work can be applied to industry. Th are, for example, the problems of suiting the j to the man, suiting the man to the job and i proving performance. The problem of suiting t man to the job includes the study of the design machinery and instruments and their lay-out a illumination by maps, panels and so forth. T position, forces and gear ratios of handles, levers a other forms of control are being studied, togetl with methods of getting the best results in jobs o boring but responsible nature. The effects of fatig discomfort and noise and the intellectual aspects industrial work also need study. This Unit h attached to it an Industrial Research Board tea which has devised tests of mechanical ability a of performance and other qualities; it is studyi night vision, the capacities of blinded office problems of the special senses and temperament differences in the ability to control machinery. F the study of the improvement of performance has invented devices which will be useful in indust after the War. A new type of recording system h been invented for the tracing of causes of absenteeis sickness and accidents, and this is being establish in a group of coal mines and in two factories. Th Unit hopes for the collaboration of the Nation Institute of Industrial Psychology and other bodi doing similar work and with managers, safety office and medical men. The Unit has a scheme by whi factories send to Cambridge representatives who c be trained there to study their problems in the own factories.

It will be clear from this brief summary of t contents of the important publications mentione that carefully thought-out plans exist for t amelioration and eventual eradication, wherever th is possible, of industrial health risks. It is evide that the workers will help industrial health researc by every means in their power and that the medic profession and many managers are no less eager solve this national problem. Not the least importa of its many aspects is the one to which Sir Edwa Mellanby referred. Much valuable information w obtained in the interval between 1918 and 193 but this information was largely left unnotic until the present War began. Then its value becan widely recognized and industrial health researc is now considered essential. Sir Edward warne s that this may be only a war reaction. We must, insisted, see to it that all who are concerned with dustry do not cease, after the War, the efforts ey are now making to create an efficient industry ased on the health and contentment of the industrial orker.

G. LAPAGE.

USE OF TREES AND SHRUBS AS FOOD FOR CATTLE

N many parts of the British Empire, the feeding of excessive numbers of low-grade stock has ecome a serious problem, not only for the forester ut also for the agriculturalist. In an article in the *ndian Forester* (Civ. and Milit. Gazette, Lahore, Dec. 944), J. A. Wilson, of the Madras Forest Service, iscusses the place of fodder from trees and shrubs the "Agricultural and Forestry Economy of adras", a problem to which many of the newly unded soil conservation committees in the Colonies d elsewhere will have to give serious consideration.

It has been the practice in India in the hot-weather eason and during serious famines to look to the rest for fodder for the villagers' often large herds f a very low type of cattle; the animals browsing n the trees, shrubs and young regeneration. "In ommon with the rest of India," Mr. Wilson writes, 'the cattle population of Madras is excessive; specially is this so in dry areas and areas of eserved forest, where cattle of low efficiency and ittle value can eke out a living at extremely low ost. . . . The concentration of scrub cattle in such reas, combined with the extension of agriculture to bsorb waste lands, previously at the disposal of the attle, has resulted in the complete denudation of grass cover over vast areas, except during the relatively short monsoon period. In the reserved forest f the dry districts also, the pressure of the grazing nimals is high, and marginal areas are for the most part badly overgrazed. While the agriculturalist provides for his utility animals during the hot weather he cannot afford to do so for his scrub animals. From February onwards therefore they have to depend on whatever cheap fodder they can pick up." From March onwards trees and shrubs put on new foliage, and the forest by the dual acts of browsing and lopping has to suffer to keep this low-grade stock alive.

It has long been the aim and the policy of the forest officer in India to bring to an end this gradual degradation and impoverishment of the forests, annually overgrazed under more or less direct orders from the civil government. The necessity, in the economic gain, for this long-continued practice is now being called in question, and not in India alone. More up-to-date management of the cattle is being considered, based on a sound soil and water conservation policy in all dry districts; improved pasture management over extensive areas of grazing grounds, involving a limitation of the head of cattle using the area and rotational closing; the storing of surplus monsoon fodder in hayricks and barns or by the preparation of ensilage.

In *La Forêt Quebecoise* (9, Jan. 1, 1945, Quebec), after an interesting account of the advent from Europe to New York and eventually to Quebec of the elm disease and the large loss of trees sustained, an author has a most valuable article on this question of forest pasturage under the title "Méfaits du paturage" with some excellent illustrations, which demonstrate his contention that unchecked grazing and browsing in a forest means its ultimate extinction owing to the impossibility of maintaining successful regeneration to replace the old trees. "La Forêt," says the author, "ne peut servir de paturage et rester en même temps productive. Soumise à cette pratique désastreuse elle abandonne infailliblement sa fonction principale qui est de produire du bois ou de la sève, et elle ne fournit en même temps qu'une pâture de bien pauvre qualité."

ELECTROMECHANICAL ANALOGIES

ELECTROMECHANICAL analogies and their use for the analysis of mechanical and electromechanical systems form the subject of an interesting paper (*J. Inst. Elec. Eng.*, 92, Pt. 2, No. 52; April 1945) by Dr. A. Bloch. After some introductory remarks which outline the problem and special features of its treatment, the author explains how the complex notation and the impedance concept can be applied directly to the analysis of mechanical systems. This leads naturally to the first or 'direct' method of constructing an electrical 'model' of a mechanical system, where a mechanical force is represented by a voltage, and a mechanical impedance, that is, the ratio of a force to a velocity, is then represented by a proportional electrical impedance. In this analogy a mass is represented by an inductance. It is shown that this representation, when established for one particular frequency, is valid for all other frequencies.

There exists a perfectly consistent alternative method of constructing such an electrical model in which all these correspondences are replaced by their dual counterparts and which is therefore called the 'indirect' or 'inverse' analogy. A mechanical force is here represented by an electric current and a mechanical velocity by a voltage. Accordingly, a mechanical impedance is then represented by an electrical admittance of proportional magnitude; in particular, a mass is represented by a capacitance. This analogy has the advantage that it enables a circuit diagram of the electrical model to be copied from the diagram of the mechanical system, if this be drawn in accordance with certain conventions. The circuit diagram found by this method is the dual of the circuit found by the first method; and as it is a routine procedure to draw the dual of a given network, the second analogy may also be useful when utilizing the first type of analogy.

The paper supplements the development of this method by showing how levers fall into the general scheme of this geometrical correspondence if they be interpreted as auto-transformers. It also shows how the circuits of both these analogies may be found with advantage by an alternative method, that of a 'method of successive generalization' of simplified systems—again without the need of establishing the equations of performance of the system. When the circuit of the inverse analogy cannot be drawn in a plane without crossing between its branches, certain difficulties arise the solution of which is dealt with in a separate paper to be published elsewhere.

Combined electrical and mechanical systems are next discussed in the paper. If the mechanical system is represented by an electrical model, then the electromechanical converter which links it to the electrical system can usually be replaced by a passive electrical four-terminal network (provided the right type of analogy be chosen for constructing the model), and in this way a purely electrical system is reached. The type of analogy to be chosen is the direct one if the electromechanical converter utilizes the action of the electrostatic forces, and the inverse analogy if the converter utilizes electromagnetic forces. Two appendixes give examples of the application of these methods to the treatment of purely mechanical and of electromechanical systems.

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Assistant Master to teach Mechanical Engineering Subjects in the Redhill Technical College to Ordinary National Certificate, and also Engineering Subjects in the Junior Technical School—The Clerk to the Governors, Education Department, Town Hall, Reigate. Surrey (August 10).

Lecturer in Organic Chemistry, and a Lecturer in either Analytical Chemistry or Physical Chemistry—The Registrar, King's College, Newcastle-upon-Tyne (August 11).

Teachers (2) of Mechanical Engineering Subjects to Higher National Certificate standard, in the East Ham Technical College—The Chief Education Officer, Education Office, Town Hall Annexe, Barking Road, London, E.6 (August 11).

Engineering Editorial Assistant for work in London—The Ministry of Labour and National Service, Appointments Department A.9, Room 670, York House, Kingsway, London, W.C.2, quoting C.2454.A (August 11).

Engineers (mainly Civil Engineers), Chemists, Physicists and Architects, at the Building Research Station, Garston, Watford, Herts, for research and other technical work on building—The Ministry of Labour and National Service, Appointments Department A.9, Room 670, York House, Kingsway, London, W.C.2, quoting D.S.I.R. (August 11).

Assistant Lecturer in the Department of Economics—The Registrar, University College, Singleton Park, Swansea (August 11).

Chemistry Master in the Secondary Technical School—The Clerk to the Governors, South-East Essex Technical College and School of Art, Longbridge Road, Dagenham (August 13).

Principal of a Training College for Technical Teachers which is to be set up in Lancashire in the near future—The Secretary, Ministry of Education (Teachers' Branch), 14–22 Lennox Gardens, London, S.W.1, endorsed 'R.E. (Technical Appointment)' (August 13).

Teacher of Engineering Subjects, particularly for Electrical Sciences in the Day School and Electrical Engineering in the part-time day and evening classes for National Certificate, City and Guilds Courses, etc., in the Cambridgeshire Technical College and School of Art—The Chief Education Officer, Shire Hall, Cambridge (August 14).

Lecturer in the Science Department (duties to include instruction of classes in Mathematics to Degree standard with, if possible, Physics as subsidiary subject)—The Governors, South-East Essex Technical College and School of Art, Longbridge Road, Dagenham (August 15).

Lecturer in Electrical Engineering, with subsidiary Mechanical Engineering—The Principal, West Ham Municipal College, Romford Road, Stratford, London, E.15 (August 15).

Assistant Lecturer in the Physics Department—The Registrar, University College, Southampton (August 15).

Assistant Lecturer (Grade III) in Philosophy—The Secretary, The University, Birmingham 3 (August 15).

Economics Officer (male)—The General Secretary, National Farmers' Union and Chamber of Agriculture of Scotland, 6 Ainslow Place, Edinburgh 3 (August 15).

Donald Pollock Readership in Engineering Science—The Registrar, University Registry, Oxford (August 20).

City Electrical Engineer—The Town Clerk, Guildhall, Bath (August 22).

Psychiatrist (temporary) to the Child Guidance Clinic of the Oxford School Medical Service—The Chief Education Officer, 77–79 George Street, Oxford (August 23).

Assistant Lecturer in Civil and Mechanical Engineering—The Acting Registrar, Queen Mary College, Mile End Road, London, E.1 (August 24).

Agricultural Chemist (woman) in the Department of Agriculture, Government of Sierra Leone—The Ministry of Labour and National Service, Appointments Department A.9, Room 670, York House, Kingsway, London, W.C.2, quoting F.4342.A (August 25).

Director of the Department of Social Studies in the University of Sydney—The Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1 (August 31).

Senior Lecturer in Social Anthropology in the Department of Bantu Studies, University of the Witwatersrand—The Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1 (August 31).

Lecturer in Geography—The Secretary and Registrar, The University, Bristol (August 31).

Assistant Lecturer in Mathematics—The Registrar, The University, Sheffield (August 31).

Assistant Lecturer (Grade III) in Geology, with qualificat in Palæontology and Stratigraphy, and a Lecturer (ungrad in Social Science—The Registrar, The University, Liverp (August 31).

Chief Electrical Engineer to the Bristol Corporation Electric Department—The Deputy Town Clerk, Central Library, Coll Green, Bristol 1 (August 31).

Assistant Lecturer and Demonstrator in the Househo Arts Department—The Secretary, King's College of Household a Social Science, c/o University College, Leicester (September 8).

Headmaster—The Secretary, King Edward's School, Edgbast Park Road, Birmingham 15 (September 15).

Sir Homi Mehta Reader in Plastics, Paints and Varnish and Singhanee Lecturer in Chemical Engineering, in the Depa ment of Chemical Technology—The University Registrar, The U versity, Bombay, India (September 15).

Wykeham Professorship of Physics (theoretical)—The Registr University Registry, Oxford (September 29).

Assistant Lecturers (2, Grade III) in Applied Mathematic The Registrar, The University, Liverpool (October 1).

Lecturer in Philosophy in the University of Melbourne—T Secretary, Universities Bureau of the British Empire, c/o Univers College, Gower Street, London, W.C.1 (October 15 in Melbourne).

Chair of Psychiatry tenable at the Maudsley Hospital—T Academic Registrar, University of London, Richmond College, Ri mond, Surrey (November 5).

Lecturer in Mining and Allied Subjects—The Principal, Coun Technical College, Blyth Road, Worksop, Notts.

Lecturer in Physics to Inter. B.Sc. standard—The Princip Guildford Technical College, Guildford, Surrey.

Lecturer (part-time) in Chemistry (Matriculation and Int standard) at the Plymouth and Devonport Technical College—T Director of Education, Education Offices, Plymouth.

Assistant Lecturer and Demonstrator in the Physics Depar ment—The Secretary, King's College of Household and Social Scien c/o University College, Leicester.

Librarian—The Secretary, Woolwich Polytechnic, Woolwic London, S.E.18.

Laboratory Technician (Biochemical Analysis), preferably wi experience in Micromethods—The Hon. Secretaries, Royal Hospit for Sick Children, Edinburgh.

Laboratory Technician (Grade B) for work involving the chemic estimation of vitamins—The Secretary, National Institute for R search in Dairying, Shinfield, Reading.

Mechanical Inspector of Works (temporary) by the Govern ment of Sierra Leone, for the Electricity Branch of the Public Work Department—The Ministry of Labour and National Service, Appoin ments Department, Sardinia Street, Kingsway, London, W.C. quoting Reference No. O.S.605.

REPORTS and other PUBLICATION

(not included in the monthly Books Supplement)

Great Britain and Ireland

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NATURE

No. 3954 SATURDAY, AUGUST 11, 1945 Vol. 156

CONTENTS

Page

omic Energy: an International Responsibility . 153
n-Power and Training in the Scientific Instrument ndustry 154
lcanic Forms and Structures. By Prof. Arthur Holmes, F.R.S. 156
ild Guidance Grows Up. By Dr. Alan Maberly . 157
lmatology for Meteorologists. By Prof. D. Brunt, F.R.S. 157
e Race Problem in South America. By Prof. A. R. Radcliffe-Brown 158
e Secretion of Milk. By Prof. H. D. Kay, O.B.E., F.R.S. 159
rvico-Facial Pigmentation (Melanosis of Riehl-Poikiloderma). By Dr. Georges Garnier 163
ws and Views 165
tters to the Editors:
  Insecticidal Action of D.D.T.—J. R. Busvine . 169
  Cation and Anion Permeability Constants for the Muscle Fibre Membrane.—Prof. E. J. Conway and P. T. Moore 170
  Anti-bacterial Action of 'Polyporin' against Typhoid, Cholera, Dysentery and *B. coli.*—Prof. S. R. Bose 171
  Microbiological Assay of Riboflavin.—Stanley A. Price 171
  Records of *Culex* (*Barraudius*) *modestus* Ficalbi (Diptera, Culicidæ) obtained in the South of England.—John F. Marshall, C.B.E. 172
  Granules of the Human Polymorphonuclear Leucocyte.—Major J. F. A. McManus . . . 173
  Origin of Haploid-Diploid Twin Embryos in Angiosperms.—Dr. P. Maheshwari 173
  Origin of Toxicity to Fungi in Wareham Heath Soil.—Dr. M. C. Rayner 174
  Nutritive Value of Coco-nut.—Dr. J. M. Vandenbelt 174
  Spectral Analysis of Solid Substances.—Dr. J. Eeckhout 175
  A Tetrabromide of β-Phellandrene.—P. A. Berry and Prof. A. Killen Macbeth 175
  Symbols Used to Indicate Hydrogen Ion Concentration and Similar Quantities.—Dr. D. Clibbens 176
  Unshrinkable Wool.—W. J. P. Neish and Prof. J. B. Speakman 176
  A New Test for 2 × 2 Tables.—G. A. Barnard 177
  Crystal Structure of Barium Titanate.—W. F. Forrester and R. M. Hinde 177
  Particle Shape.—A. H. D. Markwick . . . 177
Research Items 178
Swedish Oceanography during the War. By Prof. Hans Pettersson 180
Ceratium and Marine Hydrography. By Prof. F. E. Fritsch, F.R.S. 181
Carnegie Trust for the Universities of Scotland . 182
Universities and the Needs of the Community . 183
Tunas of the Pacific 184
A Meteoric Theory of the Origin of the Earth and Planets 185

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ATOMIC ENERGY: AN INTERNATIONAL RESPONSIBILITY

THE announcement by President Truman on August 6 that the United States Air Forces have used an 'atomic bomb' against the Japanese army base at Hiroshima was accompanied by the issue by the Prime Minister of a statement prepared by Mr. Winston Churchill some time ago on the history of the plans made in connexion with this project. The early stages of the research work involved were carried out mainly in the universities of Britain, particularly at Oxford, Cambridge, the Imperial College of Science and Technology, Liverpool and Birmingham. The Ministry of Aircraft Production was responsible for the work, being advised by a committee of scientific men. In 1941 the project was brought before the Chiefs of Staff Committee, which gave it the maximum priority.

At this time a special division of the Department of Scientific and Industrial Research was set up to direct the work, which was given the title of Directorate of Tube Alloys; and a consultative council and a technical committee were appointed. Both university and industrial laboratories were pressed into service; throughout, leading men in Britain associated with the physics and chemistry of atomic structure were brought in. In the autumn of 1941, President Roosevelt suggested closer relations with American men of science working on the same subject, as a result of which there was a fusion of efforts and several workers went from Britain to the United States to continue their researches. A year later such progress had been made that it became necessary to decide where the enormous plants which would apparently be necessary for large-scale production should be erected; since Great Britain was already fully occupied and on account of the relative security from interference afforded by the United States, that country was chosen. Most of the prodigious cost now fell on the United States. Canada also came in, providing part of the raw material and facilities for one section of the work.

Such is the bare outline of the genesis of the atomic bomb, the secret of which was well kept. But the matter cannot be allowed to rest there. On the face of it, some of the ablest scientific brains of the United Nations have been devoted for a period of years to the production of an engine of destruction; this is not, however, the whole story. For many years past it has been known that the break-up of the nucleus of an atom would lead to the release of great amounts of energy; and several writers with scientific knowledge and interests have based fascinating and almost prophetic stories upon the possibility of its achievement. During all this time scientific research has been going steadily on, step by step, delving into the interior of the atom. In time, there can be no doubt that the release of atomic energy would have been achieved; but the outbreak of war, with its threat to the world, made atomic energy a prize which would speedily sway the battle, and men and resources were provided regardless of cost. As in many other cases which could be quoted, war sharpened the interest in research of those who control the public purse, and as a result every facility was provided for promoting an investigation which in peace-time would probably have received scanty support. It is known that the Germans as well as ourselves were seeking the solution ; but, fortunately for the world, they were not able to achieve practical results.

Nevertheless, the very successfulness of the investigation induces a feeling akin to dismay that science should contribute such an engine of destruction to the world. This feeling must be put aside, though the possibilities must never be forgotten. We must remember that this new source of energy now being tapped, "long mercifully withheld from man", as Mr. Churchill wrote, can and must in the years of peace be harnessed to the needs of industry, to supplement the forms of power now in use. Research into the regulated release of atomic energy, if this has not already been achieved, will be carried on from a new basis and with redoubled energy. No doubt much painstaking work will be necessary before the new source of energy can be utilized in economic competition with fuel and wind- and water-power, but the present position clearly holds possibilities of the utmost significance.

There is another facet of the world situation which this scientific and technical development has brought to the forefront, namely, the immense responsibility now placed in the hands of those with exact knowledge of the steps necessary to release atomic energy. It has been stated that adequate measures have been taken to secure patents on all vital processes, and all rights in such patents have been assigned to the Governments concerned. At present, this must mean that the United Nations, and especially Great Britain, the United States and Canada, hold in their hands a weapon with which they can dominate the world—a responsibility the discharge of which will require the highest degree of statesmanship. They also hold a potential source of power capable of contributing immensely to the welfare and material progress of mankind—a further and even greater responsibility. How will they use it ? Governments are notoriously impersonal, and they come and go. It therefore devolves upon the individual, be he man of science or layman, to understand the potentialities of atomic energy, even if he comprehends little of the method of its release ; and to ensure that his elected representatives, from whom his Government is chosen, are also aware of their responsibilities in the matter. It is not a matter of exact knowledge so much as an appreciation of right and wrong in dealing with our neighbours, who are now every nation of the world ; indeed, the alternatives would seem to be an international brotherhood of nations or chaos. There can be no question of halting investigations until mankind is fitter to receive them ; if material research has outstripped the progress of knowledge of man, then the tempo of investigation of man as a social being must be increased until both can progress, side by side, carrying man onwards to the higher ideals of life for which the best of each generation are always striving.

MAN-POWER AND TRAINING THE SCIENTIFIC INSTRUMENT INDUSTRY

IN an article in *Nature* towards the end of 194 attention was directed to the dependence on live and efficient scientific instrument industry Britain of the hopes that the technical and resea resources and facilities of industry would be rais to a level which would allow of full application bei made of scientific knowledge and of advanceme in that knowledge. Further, it was pointed out th in no branch of industry is the need of techni knowledge and facilities greater than in the scienti instrument industry. At the time these observatio were made, the manufacturers of scientific instr ments and equipment were completely occupied fulfilling the demands of the Government in respe of war requirements and, indeed, this state of affa still persists. It is, however, reasonable to suppo that the post-war period now lies in the near, rath than in the distant, future, and it is opportune review the position of the manufacturers of scienti instruments and of laboratory equipment in relati to their ability to meet their vital commitments the nation during the period of the re-creation national prosperity.

Two factors which are vital to the efficient manu facture of scientific instruments and equipment a craftsmanship and technical knowledge in its wide sense and, while neither was in a very healthy con dition before the War, both have certainly bee adversely affected by the War. The desperate de mands on man-power of the Fighting Services durin the past six years have inevitably resulted in th scientific instrument industry, in common with a other industries, being engaged in a losing battl with the Ministry of Labour and National Servic for the retention of its craftsmen and technicians Moreover, for six years the industry has been en gaged in the mass-production of instruments fo Service use, and it will be appreciated that, excellen as the British war-time instruments have been, there is a vast difference between the delicacy of instru ments designed for accurate measurement unde reasonable conditions and that of instruments required to be as accurate as possible under the very robust conditions which must exist in the tank aeroplane and other engines of war. In consequence the craftsmen, generally those of mature age and experience, who have remained in the industry have not been required to exercise their craft to the full, and will, to some extent, have to regain their skill. As regards technicians, the demands of the research and development departments of the Services have been such that it has been impossible for the industry to avoid losing much of its technical personnel, and have prevented any recruitment being made by the industry to make good its technical deficiencies. Further, the large extent to which development has taken place within Service departments has reacted unfavourably on the maintenance of efficient development in the industry itself. The industry therefore faces its post-war commitments under the shadow of a very serious deficiency both in craftsmen and technicians; and, in view of the vital function of the scientific instrument industry in the national life, the position calls for serious thought and remedial action.

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* *Nature*, 152, 704 (1943).

It has already been remarked that craftsmanship and technology within the scientific instrument industry—and indeed in all industries—have not been what they should or might have been; and it is an encouraging sign that there is a general recognition of this fact within the industry itself, and that serious consideration is being given to the means of ensuring a marked improvement in the future. It is evident, however, that any policy which may be adopted to this end must be a long-term one, for neither craftsmen nor technicians in sufficient numbers can be produced by any means other than by education and training over a long period. It is well that such a policy should be pursued, but it must be realized that three immediate tasks, which cannot depend on any long-term policy, confront the industry: the home demands for instruments and equipment in the industrial, educational and other civil spheres must be met, and it should be noted that the industry is already some two years behind in the fulfilment of orders; the industry must take its full share in the rehabilitation of the technical facilities of liberated Europe; the industry's export trade has to be recovered and extended, and it is relevant to observe that foreign governments have long realized that the scientific instrument is, from every point of view, the ideal article for export. If these tasks are to be carried out with some measure of adequacy, a short-term policy must be evolved which will ameliorate the conditions at present existing in the industry. The continuing war in the East must necessarily restrict the possibility of certain procedures being adopted, but it is well to state the actions which might be taken to instil confidence in the industry as it faces these tasks, and to increase its competence to carry them out. Three of these actions may be briefly stated. There are craftsmen in the Armed Forces whose service may continue for some considerable time: their release would confer great benefit on the industry. There are young craftsmen who have achieved a considerable degree of skill but who will normally be called up for service in the near future: their retention in the industry is most desirable. There are older and more mature craftsmen in the industry who have been long starved of the opportunity to exercise their peculiar skill in full measure: encouragement to the industry to recommence, even on a limited scale, the manufacture of its civil and export products would not only provide a preparation for production for the future, but also would furnish an excellent refresher course for these craftsmen. No such encouragement has yet been received.

What has been said of craftsmen applies, to some extent, to technicians, but the formulation of a short-term policy to meet the technical needs of the industry presents considerable difficulty. Scientific instruments and equipment are produced in Britain by relatively small firms which are distributed over the whole of the country, and, in consequence, it is almost impossible that adequate technical facilities should exist in every individual firm. Here then surely is a case in which, certainly for some years, a considerable proportion of the technical, and especially the research, facilities of the industry must be found in its research association. The British Scientific Instrument Research Association has evolved a scheme of expansion which, if quickly achieved, should go a long way towards covering the whole field of problems associated with the manufacture of scientific instruments. It would seem that in whole-hearted co-operation with its research association lies the best hope of the industry to resolve its technical difficulties, at least until any long-term policy to deal with the technological aspects of instrument production has had time to affect the situation.

Any immediate action which may be taken to meet the pressing need of the moment should in no way prejudice the pursuance of policies by the industry to overcome deficiencies in craftsmanship and technology. In a book recently published*, Mr. F. Twyman has described the rise and fall of the apprenticeship system and has put forward a passionate plea for its revival. It is only too frequently true that apprentices to-day receive no systematic instruction in their crafts but have of necessity to pick up their knowledge as best they may. The training of apprentices cannot be fully efficient while their work is considered to be an integral part of production, and it would be of inestimable worth to the industry if a scientific instrument apprentices school were established from which a steady stream of trained craftsmen could flow into the industry and thus provide a solid core of craftsmanship. The wide distribution of the industry renders any local system of training very difficult, but it is conceivable that united action by the entire industry might evoke the co-operation of the Ministry of Education and result in the establishment of a true school of apprenticeship for scientific instrument makers, which might effectively resolve the question of craftsmanship and would constitute a national asset. The provision of technicians in the industry will be vitally affected by the nature of academic and technical education in the future. In this connexion the recommendations of Lord Eustace Percy's Committee will be awaited with interest. Again, the hope may be expressed that in the post-war period a far more adequate liaison will exist between the academic scientific worker and the industrialist than has been the case in the past. The research association movement has now achieved considerable dimensions and a large measure of stability, and forms a very useful halfway house between science and industry. The research association would seem to provide a very convenient channel through which scientific men who desire to enter industry might well pass in their transition from academic to industrial life.

Long-term policies, however, cannot affect the immediate future. There is every reason to anticipate that victory over Japan will not be long delayed, and that, in the near future, industry in Great Britain will be called upon to make perhaps its greatest effort in order to secure the future well-being of the country. There is no more important tool in industry than the scientific instrument, and it is to be hoped that no unnecessary restriction imposed at the present moment will cause the manufacturer of scientific instruments to falter when the demand is made on him for the tools vital to the technical rehabilitation of our national life.

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* "Apprenticeship for a Skilled Trade." By F. Twyman. (London: Charles Griffin and Co., Ltd., 1944.) 5s. net.

VOLCANIC FORMS AND STRUCTURES

Volcanoes as Landscape Forms

By Prof. C. A. Cotton. Pp. xv+416. (Christchurch and London: Whitcombe and Tombs, Ltd., 1944.) 32*s*. 6*d*.

It is no accident that the varied landscapes of New Zealand should have stimulated Prof. Cotton to enrich the literature of geomorphology with a series of books of outstanding interest and importance. In no other country of comparable size can a greater variety of geological agents and processes be seen in active operation, and since land-forms result from the interaction of the internal and external processes, it follows that New Zealand is a geomorphologist's paradise.

In his latest work Prof. Cotton gives us for the first time a detailed and systematic account of volcanic land-forms and their subsequent modifications. Along this line of approach, discussion of theories of vulcanism and petrogenesis is not to be expected. Nevertheless, the author devotes six introductory chapters (Part 1) to the mechanism of volcanic activity, and when he comes to volcanic landscapes (Part 2) he continues to adopt a treatment which, throughout the ten chapters dealing with the primary forms of construction and destruction, is quite rightly genetic as well as descriptive. The last two chapters, which deserve expansion and might well have formed a third part, are concerned with the erosion and dissection of volcanic plateaus and mountains. Volcanic contributions to atmosphere and ocean are briefly discussed in an appendix.

The author emphasizes the fundamental distinction between (*a*) dominantly lava volcanoes, mainly basaltic, and characterized by relatively quiet effusion; and (*b*) dominantly pyroclastic volcanoes, generally emitting more silicic materials and characterized by explosive eruptions, which not infrequently reach catastrophic intensity. An attempt is made to correlate this striking contrast in behaviour with the chemical compositions of the lavas concerned. Attention is directed to the importance of iron oxides in promoting mobility and high temperature (by reaction of Fe_2O_3 with juvenile hydrogen), and it is surmised that the high viscosity and lower temperature at which the more silicic lavas commonly arrive at the surface may be partly due to their lower content of iron. The development of this idea in relation to other elements is less happy. Thus, after suggesting that the peculiarities of the Vesuvius eruptions may be related to the highly potassic character of the lavas, the author goes on to say (p. 63): "The lava of Etna also is a potash-rich basalt, and the activity of Etna is not very unlike that of Vesuvius". Actually, the lavas of Vesuvius are leucite-tephrite with 7·5 per cent of K_2O, while those of Etna are andesitic basalts with only 1·6 per cent. Moreover, on p. 47, it is wrongly assumed that the dome-building volcanoes of central Africa are basaltic. Far from being basaltic, the lavas of Nyamlagira and Ninagongo are felspathoidal types with 3·5 and 5·5 per cent of K_2O respectively. These examples add point to the author's own warning (p. 63), based on the eruptions of Tarawera, "against too confident prediction of the eruptive properties of magmas from chemical composition".

Other warnings may not be out of place in relation to Part 1. Admittedly the problems of mechanism remain intractable, but no useful purpose is served by the uncritical reiteration of immature or untenable hypotheses. Jaggar's conception of the mechanism responsible for the Hawaiian cycle of activity might be of value if it were intelligibly expressed, but on pp. 33–34 the author, like earlier writers (including Jaggar himself), merely succeeds in befogging the reader. Again, in dealing with the sources of magma on p. 46, it is unfortunate that Hobbs's naïve and unacceptable assumption that local relief of pressure leads to the fusion of sediments should be cited, especially as attention is directed later on to the necessity for changes of composition by introduction of emanations from the depths.

Part 2 is concerned with less controversial topics and is an invaluable storehouse of information, admirably classified and discussed, and so thoroughly up to date that the new Mexican volcano, Paricutin, and the 1944 eruption of Vesuvius both receive appropriate mention. The chapters deal in turn with basaltic domes and cones; lava plateaux and plains; lava fields and their minor relief forms, including lava surfaces, fire fountains and their effects, bombs and spatter cones; coulees (the thick tongue-like convex flows of viscid non-basaltic lavas), tholoids (spreading cumulo-domes exuded in and over craters) and plug domes of piston-like protrusion; *nuée ardentes*, ash showers and ignimbrite sheets (a chapter that deserves special commendation); ash-built and stratified cones, with a good account of lahars of various kinds; maars and meteor craters; submarine eruptions and pillow lavas; craters, calderas, volcano-tectonic depressions (for example, that of Lake Toba) and volcanic lakes; the dissection of basalt and ignimbrite plateaux; and finally the erosion of volcanic mountains. In this last chapter welcome features are the accounts of erosion calderas and the planeze stage of dissection, a *planeze* being a dwindling sector of the initial constructional surface, surviving for a time between deeply eroded consequent valleys. The section on volcanic skeletons is, however, disappointingly brief. The collection and correlation of successive members of denudation series is a long-overdue task which Prof. Cotton is well equipped to undertake successfully. In particular it should be possible to trace ring structures from the surface manifestations developed on volcanoes such as Kilauea, Mauna Kea and Niuafo'ou, down to the ring-dykes and cone-sheets revealed at the roots of old volcanic centres, as in Mull. As it is, ring structures receive scant attention; and in Fig. 7 what are obviously cone-sheets are wrongly described as ring-dykes.

Such criticism as is offered above is meant to be helpful in the preparation of later editions, for the book as a whole is so good that it should soon progress from youth to maturity. It will be welcomed and appreciated by a wide circle of readers—for who is not interested in volcanoes ?—and more especially because the author, apart from his own valuable contributions, has made readily available, with full references, the scattered results of such active vulcanologists as Jaggar, Perret, Stearns and Howel Williams. Apart from the price, the book shows no signs of being a war-time production, but is attractively printed and profusely illustrated on good-quality glossy paper. Author and publisher alike are to be warmly congratulated on their combined success in the fields of scientific exposition and craftsmanship.

ARTHUR HOLMES.

CHILD GUIDANCE GROWS UP

An Introduction to Child Guidance

By W. Mary Burbury, Edna M. Balint and Bridget J. Yapp. Pp. viii+200. (London: Macmillan and Co., Ltd., 1945.) 7*s*. 6*d*. net.

VERY little has been published in Great Britain on the work of child guidance clinics, and ignorance on the subject is widespread. It is therefore perhaps ungenerous to criticize the authors of this small book for attempting to cover too wide a field or to address too wide an audience. The fact remains that many aspects of the work have received but scant reference, and the authors' hope to meet the needs of "all those who are actively concerned with the problems of children and young people, whether as members of education or youth committees, as magistrates, probation officers, teachers, doctors or social workers . . . and . . . also be found useful by students intending to work in child guidance clinics, as well as by those studying education, social science, psychological medicine or pèdiatrics" is too ambitious. While child guidance as a team approach to the problems of childhood strictly emanated from the United States, when the demonstration clinic was founded in London with Commonwealth Fund monies in 1928, Prof. Cyril Burt had been doing work on similar lines since 1909. Before the East London Child Guidance Clinic was opened in 1927 a pioneer group of medical men at the Tavistock Clinic, some of whom later became directors of the early clinics, dealt with more than five hundred children, assisted by a social worker who was one of the first to train in the United States and qualify as psychiatric social worker. Since that time child guidance in Great Britain has developed its own essentially British characteristics, and as every young movement needs to be jealous of its reputation and avoid inviting deserved opposition, one must needs be critical of matters that might otherwise be passed over as details.

Some duplication and contradiction is inevitable in any symposium, but slightly more careful editing might have prevented the introduction of technical terms before their description or definition. The term "intelligence quotient" is introduced in Chapters 3 and 6, and the reader has to wait until Chapter 8 before finding any explanation. Similarly, in one chapter the suggestion is made that maladjustments of foster children could be avoided only if there were panels of specially selected homes, but no mention is made of the Foster Home Register until nearly a hundred pages further on. I think one might also question undesirable jargon such as "neurotic reasons" in relation to adoptive parents, "dreaded rival" as a description of a boy's attitude to his father, "supernormal" for intelligence above the average, and the reference to "rationalisations more or less unconscious". The use of this kind of language justifies the criticisms on the part of the layman to which Dr. Burbury refers in her introduction. Keeping the general reader in mind, debatable statements might well be omitted, such as that foster mothers undertake the care of children primarily as a congenial method of adding to their income, that the mother whose brass knocker is always the brightest in the street and whose windows gleam in front of spotless white curtains is an obsessional neurotic who can never rest, or that the child who lies awake for long hours is commonly masturbating. Such situations may and do occur, but it would be a pity if the reader were tempted to generalize and the captious critic provoked to caustic comment.

Perhaps the best part of the book is the last, dealing with the methods of examination and treatment, although psychotherapy of children is a particularly difficult subject to describe clearly to the outsider. Chapters 7 and 12, on the job of the psychiatric social worker, are especially well done, and Chapter 14 on future trends is thoughtful and stimulating although it touches only on the fringes of what could and should be done in the preventive fields. Child guidance stands for one of the earliest approaches to children's problems along the lines of social medicine, investigating and attempting to correct the causes of maladjustment of the individual to his environment. It is "concerned primarily with unsatisfied inner needs rather than with physical or intellectual difficulties", but such dissatisfaction gives rise to many types of symptom, and treatment stands as much for environmental change as individual therapy. The scales are carefully balanced between the rights of the individual and the demands of society, and there is reason to hope that the principles that underlie child guidance may expand far outside the clinics into the schools and homes of the people.

It may be hoped that this small work will have a reception that will encourage its authors and others working in the same field to write further and more comprehensive books on the subject.

ALAN MABERLY.

CLIMATOLOGY FOR METEOROLOGISTS

Climatology

By Prof. Bernhard Haurwitz and Prof. James M. Austin. Pp. xi+410+17 plates. (New York: McGraw-Hill Book Co., Inc., 1944.) 4.50 dollars.

THE authors of this book set out to provide an introduction to climatology for the student of meteorology. Since the public which they aim at interesting is meteorologically educated, the authors are free to use meteorological terms, and they have made use of this freedom to write a book on climatology which is rather different from any other book on this subject. In the course of the last two decades, synoptic meteorology has been steadily progressing, mainly along the lines of analysis of weather charts developed at Bergen in Norway. Weather is now interpreted in terms of air masses and of the fronts which separate them, with an enormous gain in understanding of the physical processes underlying the changes of weather with place and time.

Climatology may be defined, perhaps a little crudely, as the time-integral of weather, and so there should be a close correlation between the interpretation of climatic data and the interpretation of the facts depicted on the synoptic chart over a selected interval of time. Hitherto this correlation has not been very obvious in the text-books of climatology.

In the book under review, Profs. Haurwitz and Austin have broken new ground in endeavouring to interpret climatological data in terms of air-masses, and their book is a definite step forward in the development of climatology. The book is in two parts, the first dealing with general climatology, the second with regional climatology. Under the heading of general climatology we find a discussion of solar radiation and heat balance of the atmosphere, temperature, wind and pressure, hydrometeors, air masses, fronts, cyclones and anticyclones. The discussion of these topics is of necessity brief, but is perhaps ample for the purpose of the later sections of the book. Many of the diagrams used have not hitherto appeared in text-books, and the authors are to be congratulated on their effective choice of diagrams for illustrating these early chapters. In the subsequent chapters of the first part of the book, the authors describe in some detail Köppen's classification of climates, in the form which this classification finally took (Köppen-Geiger, "Handbuch der Klimatologie", vol. 1C). This is the classification which the authors adopt as the basis of the second part of the book. But between the chapters describing the types of climate and those dealing with regional climatology is interposed a chapter on micro-climatology, which seems curiously aloof from the rest of the book. What is in general called micro-climatology is not in reality climatology, and could more logically be called micro-meteorology. The inclusion of a chapter on the subject in the middle of the present book appears to the present reviewer a tactical error, since it is a barrier to the smooth development of the plan of the book.

The second part of the book deals with regional climatology of the globe, dividing the globe into eight areas, and devoting one chapter to each area. In each chapter are discussed briefly the physical features, the mean distribution of pressure and wind, ocean currents, the prevalent air-masses, fronts, cyclones and anticyclones, and the climatic types occurring within the area. The amount of information given under each heading varies from area to area. For example, the accurate description of air masses over most of Africa is not possible in the absence of adequate upper air data, and the brevity of the three chapters dealing with Australia and New Zealand, with arctic and antarctic, and with oceanic regions, is to be ascribed to the inadequacy of certain types of data from a very large part of the globe.

Each of the eight chapters contains tables of frequencies of wind directions in January and July for a selection of stations, and tables of mean temperature, precipitation, and cloudiness in January, April, July and October, for a number of selected stations. The times of observation are not stated.

A revolution in the method of presentation c climatological data appears to be inevitable, but muc intense work will have to be done before this revolution is achieved. The authors of the present boo have made a beginning, and it is likely that shortl there will be much fuller meteorological dat available for nearly the whole globe, the discussion of which will make it possible to give fulle treatment of many of the topics they have discussed.

The book under review is to be recommended t all who take an intelligent interest in climatolog be they meteorologists or geographers.

D. BRUNT.

THE RACE PROBLEM IN SOUTH AMERICA

El Indoamericanismo y el Problema Racial en la Américas

Por Prof. Dr. Alejandro Lipschutz. Segunda edicion Pp. 501+32 plates. (Santiago: Editorial Nascimento, 1944.) n.p.

PROF. LIPSCHUTZ explains that what he means by Indo-americanism is the vindication of the economic and cultural rights of the masses of Indians and mestizos of America, who have been up to the present "disinherited". His book is a plea for an "Indo-american resurrection", which, it may be noted, has already been partly brought about in Mexico. He attacks what he calls "racial hypocrisy", that is, the justification of the inferior social position in which certain portions of the population are kept, by the excuse that those of American Indian or African Negro blood are racially inferior to the descendants of Europeans. A considerable part of the book is a discussion of the supposed biological inferiority and superiority of different races of mankind, and the degeneration that is popularly supposed to result from racial miscegenation. He deals not only with the American Indians but also with the African Negro, and makes use of the abundant anthropological literature that now exists on this subject.

The racial problem, as the author says, is not really a biological but a social problem, and it presents itself in different forms in different countries. What Prof. Lipschutz is concerned with is that the descendants of the conquered Indian tribes and of the African slaves constitute what may be called a deprived class condemned by the present social system to occupy, economically and culturally, an inferior position. This, he thinks, must be remedied by a widespread social reform if the Spanish American republics are to survive as independent national entities by the side of the United States within a united American continent.

The author thinks that the future of the whole American continent depends on the racial problem of North America. He recognizes the gravity of the problem of racial discrimination against the Negroes of the United States, but finds some grounds for optimism in the fact that sixty or seventy years ago the American Indians were in that country regarded as an essentially inferior race and that the attitude towards them has now greatly changed.

A. R. RADCLIFFE-BROWN.

THE SECRETION OF MILK*

By Prof. H. D. KAY, O.B.E., F.R.S.

National Institute for Research in Dairying, Shinfield

OUR knowledge of the cytology of milk secretion—what structures in the large cells lining the lveoli of the mammary gland are concerned with the formation of the various milk constituents—is meagre. There is no doubt that all the milk contituents are secreted by the same type of cell; there re not separate cells secreting fat, others secreting casein, others secreting salts and so on. It is now sually agreed also that the milk-secreting cells are airly permanent structures; that is, that milk does not originate from the breakdown and dissolution of complete cells which are renewed again and again from the basement membrane. This would entail far more mitosis and repair in cell structure than can be seen in the actual functioning gland, and would probably entail the presence in milk of fairly large amounts of substances derived from the cell nuclei, such as nucleoproteins or breakdown products of hese proteins which are, in fact, only present in traces in milk. What appears to be the case is that apart from occasional breakdown and repair, he alveolar cells maintain their nuclei and general integrity throughout a large part of a lactation period.

The day's work of one of these cubical cells entails the following cycle of operations. It begins as a rather short squat cell with the nucleus in the middle. Granules or globules, some of which stain with fat-soluble dyes, then begin to appear in the part of the cell nearest the alveolar space. The cell begins to increase in length and size, the nucleus remaining fairly close to the basement membrane. The secretory products soon fill the whole of one end of the tall, distended cell. These products, and possibly a small part of the cytoplasm of the cell itself, are now extruded into the lumen of the alveolus as milk, following which discharge the cell returns to its original squat shape. This whole process is repeated several times until the alveolar spaces become distended with secreted milk and the whole of the rest of the storage space in the gland is also occupied, whereupon further secretion ceases. During twenty-four hours in an actively lactating cow there may be up to four or five or even more cellular cycles of operation. Milk secretion proceeds continuously throughout the major part of the twenty-four hours, possibly interrupted during the actual milking process.

Though the cells are tiny compared with, say, the size of an *Amœba*, there is plenty of room inside each one for a very complicated structure, a part of which has been revealed by ordinary microscope and histological methods. The development of the electron microscope gives an increased hope of further accurate knowledge of the lay-out of these tiny factories, but it will probably be a long time before their detailed structure, the mode of action of the enzymic systems which are known to exist in these cells, and the associated biochemical changes, many of which have already been observed, and which I now propose to discuss, have been completely co-ordinated.

The Biochemistry of Milk Synthesis

It is clear that the basic materials from which milk is made, as well as those needed for producing the energy for milk secretion, must be brought to the mammary gland by the circulating blood. The main problems can be stated in the following general terms: (1) What are the chemical materials in this blood which are used for (*a*) the manufacture by the milk-secreting cells of the principal milk constituents, (*b*) as a source of energy for the work done by the active gland? (2) How is this manufacture actually brought about in these cells? In the cow, two mammary arteries, one of which serves the front and rear quarters on each side of the udder, provide the whole of the incoming blood. The arteries rapidly sub-divide to form arterioles and capillaries in close touch with the alveolar cells. A sample of blood taken from any part of the arterial system will contain all the materials either for milk manufacture or to meet the energy needs of the udder.

Three constituents of milk (Table 1), at least, are not present as such in the circulating blood, namely, milk fat, casein and lactose. Two at least of these, namely, lactose and casein, are produced nowhere in Nature but in the cells of the mammary gland.

TABLE 1. RELATION BETWEEN THE CONSTITUENTS OF COWS' BLOOD AND THOSE OF COWS' MILK.

(Quantities shown in mgm. per 100 ml.).

Constituent	Blood plasma	Milk	Ratio (approx.) blood : milk
Casein	Nil	2800–3000	—
Lactalbumin	Nil	350–450	—
Globulin	1200–2000	50–150	1 : 0·1
Lactose	Nil	4600–4900	Blood glucose : milk lactose as 1 : 80
Glucose	45–60	Traces	
Fat (as fatty acids)	150–300	3000–4000	1 : 15
Ca (total)	10–12	120–140	1 : 12.
K	16–20	120–180	1 : 9
Cl	270–300	90–120	1 : 0·4
Inorganic P	4–6	60–80	1 : 15
Total acid-soluble P	4·2–6·5	65–90	1 : 15
Lipin P	5–7	4–12	1 : 1 5
Urea	30–40	30–40	?1 : 1

Other constituents of milk are present either in much larger or much smaller concentrations than in blood. A very few, such as urea, which is freely diffusable through most of the tissues of the body, are present in equal concentration in both blood and milk. Whereas the inorganic salts of milk must clearly come from the inorganic salts of the blood plasma (for example, calcium, potassium and chlorine) it is by no means necessary that the organic constituents of the milk are derived from the more or less obvious precursors in the blood, for example, milk sugar from blood sugar.

As regards venous drainage, the system of blood vessels is more complicated. There are actually three routes by which venous blood leaves the gland, the main one being the subcutaneous abdominal vein which goes forward from the gland just below the skin (the so-called milk vein) and enters the abdomen through a small hole—the 'milk well'—in the abdominal wall. There are considerable anastomoses between the various veins, so that a sample of blood taken from the 'milk vein' gives a fair picture of the composition of the blood leaving the gland.

By comparing, therefore, the composition of the arterial blood reaching the secreting gland with that of the venous blood leaving it, one should, it would seem, be able to determine what blood constituents are being used by the gland.

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* From a Royal Institution discourse delivered on May 18.

The veins are not, however, the only channel through which circulating fluid leaves the mammary gland. There is also, as in most other active tissues of the body, a well-developed lymph drainage system, as extensive as the venous system. The lymphatic system drains the tissue spaces, whence the fluid which originates from the circulating blood is slowly but continuously removed, passed through lymph nodes (there is a particularly large lymph node, up to some 10 cm. long, on the top of the udder on each side) and by a long lymphatic channel furnished, like the venous system, with valves, and returned to the circulating blood through the so-called thoracic duct, which pours a slow stream of lymph into the venous blood of the anterior vena cava, just before the blood reaches the heart. The rate of lymph flow from the mammary gland is undoubtedly very much less than that of the venous blood flow, but in what quantitative relationship the two stand is at present a matter of guesswork. Nevertheless, any balance sheet which might otherwise be drawn up over any given period of secretion, say twenty-four hours, as between the quantity and constituents of blood entering the gland on one side, and the blood plus milk leaving the gland on the other, is complicated by this small but quantitatively unassessed expenditure from the arterial blood which does not appear either in the venous blood or in the milk itself.

The first whole-hearted attempts to discover the nature of the milk precursors gave misleading results. The particular method used was to analyse samples, taken simultaneously, of mammary venous blood and of jugular venous blood. Satisfactory methods for obtaining true arterial blood had not then been worked out, and it was assumed that the easily obtainable jugular blood, draining the head, which was considered to be a relatively inactive part of the organism, in the cow at any rate, would be fairly close in composition to true arterial blood.

This was clearly shown, by later workers at the Hannah Research Institute, not to be the case, so that one at least of the main conclusions drawn from the first experiments, that butter fat in milk was mainly derived from the phosphorized fats of the blood, was incorrect.

Most of the recent work, that is, since about 1932, has been carried out by more reliable methods. Methods of arterial sampling without disturbance of the cow have been developed in various research centres; for example, sampling from the internal iliac artery, which can be easily approached through the rectum of the animal, or principally in goats, from a portion of the carotid artery which has in a previous minor operation been exteriorized in a loop of skin. It may be said at once that the method of obtaining the blood samples is more than half the battle. It was clearly demonstrated at the National Institute for Research in Dairying, at Shinfield, in 1934, that disturbance of the animal during sampling must be avoided, otherwise analysis of the blood samples was largely waste of time. It is not at all easy to take an arterial and venous blood sample practically simultaneously without some disturbance, though individual animals vary very greatly in their perturbability.

To get over this difficulty, two other methods have been used fairly recently: one is the use of an anæsthetic, nembutal, which removes nervous exci ment and appears not to interfere with the secreto process; the other is by, so to speak, removal of t animal altogether (a method first used, tentativel by Foà some thirty-five years ago), namely, b excising the mammary gland and perfusing the latte with as little delay as possible, either with oxygenate defibrinated blood or with oxygenated whole blo prevented from clotting with a suitable anticoagulan such as sodium citrate or heparin.

None of these methods is perfect, but each has i advantages and disadvantages. The perfusion tec nique very recently developed by Petersen, Shaw an Visscher in Minnesota is one requiring much exper mental skill. It is said that the gland can be i action within seven or eight minutes of the slaughte of the cow. By this method various blood pressur can be used, various materials can be added to th arterial blood, and blood sampling, both 'arteria and venous (a single venous exit is arranged), is easy while milk can be collected without too much diff culty. The isolated gland cannot be used too long a it is, of course, steadily deteriorating, and again th question arises as to how far the interference wit lymphatic drainage affects the findings.

The nembutal anæsthesia method, also develope in the United States during the War, is said to hav no effect on blood sugar or on the rate of mil secretion in goats, or on the energy requirements o the mammary gland.

An entirely different method for the study o mammary gland metabolism is the incubation, i well-oxygenated salt solutions, of fresh slices o mammary tissue with various possible precursors o the milk constituents.

Still another method is by the use of radioactive elements such as radioactive phosphorus or calcium or of 'heavy' elements such as deuterium ('heavy hydrogen') or 'heavy' nitrogen, which, suitably combined, can be given to a lactating animal by mouth or intravenously, and followed through into the milk by appropriate physical means. This very promising method has so far been used only in a preliminary way, though Hevesy and Aten in Holland, in 1938, made a few useful observations using radioactive phosphorus.

Chemical Changes from Arterial to Venous Blood

Blood sugar. These changes are the largest in actual percentage; there is a fall varying from 10 to 25 or even 30 per cent of the total arterial blood sugar.

Blood fat. There is a fall of about 3–5 per cent in the neutral fat of the blood in passing through the gland.

Lactic acid. The position here is not yet clear. Some earlier experimenters claimed that fairly large amounts of blood lactic acid disappear while going through the mammary gland. More recent work shows little change with normal, unanæsthetized animals, but there appears to be a slight uptake by anæsthetized animals in the first twenty minutes of anæsthesia, but not, it seems, later. It is an open question whether lactic acid is or is not one of the blood constituents normally used by the secreting cells.

β-Hydroxybutyric acid. This substance, which occurs in normal cow's blood in appreciable quantities, and in animals in 'ketosis' in much larger amounts, is taken up by the mammary gland in iantities which appear to vary with the concentration in the blood.

Globulin. Apparently an appreciable quantity of asma globulin, but no albumin, leaves the blood in aversing the mammary gland. The globulin which mainly involved is a glycoprotein, the molecule of hich contains some 9 per cent of a sugar complex ntaining galactose, mannose and glucosamine. here is some evidence that plasma albumin is tually greater in mammary venous blood than in terial blood.

Amino-acids. Small quantities of uncombined nino-acids appear to leave the arterial blood, and ere is a suggestion that slightly more urea nitrogen present in mammary venous blood than arterial ood.

Inorganic phosphorus. There is a drop of about -7 per cent in the amount of inorganic phosphorus in blood plasma in passing through the land.

Calcium. A fall takes place of about 2·5 per cent the amount of calcium in the arterial blood.

Since the milk contains relatively large quantities f end-products, of which several of the materials ist mentioned must be the precursors, it is obvious hat, since there is such a small quantity of precursor emoved from unit volume of blood, the rate of lood-flow through the gland must be very high (see elow).

Mammary Gland Slices

Grant, working in Great Britain, found some years go that lactose was formed when mammary gland lices were incubated in oxygenated physiological alt solutions containing glucose, but not, apparently, f fructose, mannose, galactose or various sugar-hosphoric acid esters were used. Some of these indings were later called into question, but very ecent work of Knodt and Petersen has confirmed that lactose is formed when mammary slices are ncubated with glucose, and also with glucose plus actic acid, maltose and glycogen. It is not perhaps surprising that the last two should give positive results, since both will presumably be hydrolysed to glucose by enzymes present in mammary gland tissue. β-Hydroxybutyric acid disappeared when incubated with mammary slices, the rate depending on the amount of the acid present.

Perfusion of Excised Mammary Gland

It has been shown that tissue glycogen is increased by perfusion of the excised mammary gland with blood containing added quantities of glucose, but increased blood glucose caused no significant change in the amount of lactose secreted in a six-hour period. It is very likely that, as in other tissues, glycogen can be synthesized from various normal blood constituents by the mammary cells, and later hydrolysed again to form glucose and, through glucose, lactose. Normal mammary tissue contains about 0·2 per cent of glycogen, according to American findings.

Further sidelights on the biochemistry of milk secretion are thrown by the study of the composition of milk when the secreting tissue is infected by *Streptococcus agalactiæ*, which may persist in the gland for long periods without too seriously inhibiting the flow of milk.

In the infection known as streptococcal mastitis, the secreting cells are physiologically abnormal in that instead of true milk, a fluid is secreted in which the characteristic milk constituents lactose, casein and fat and the less characteristic but very important constituent vitamin A are diminished. There is an increase in globulin and a large increase in chloride. Davies believed that mastitis milk could be regarded as ordinary milk containing larger or smaller proportions of what he called "an isotonic diluent" approximating in composition to blood plasma, with its relatively high proportion of globulin and sodium chloride. A varying proportion of udder tissue is, in effect, in a catarrhal condition and forms an ineffective barrier against this leakage. This view has recently received some support from the finding that while in the blood plasma of a cow receiving green fodder carotene is high, in normal milk the carotene content is only 3 per cent of that in blood, but in mastitis milk (even say from one infected quarter of a cow the other three quarters of which may be still normal) the carotene may be as high as 20 per cent or even more of the blood level. Vitamin A, on the other hand, is lower in blood plasma than in milk—it is not yet certain whether the udder cells concentrate the vitamin A of the plasma or actually synthesize it from blood carotene—but in mastitis milk it is, like the fat, lower than in normal milk.

Any connected account of the processes by which milk is made in the udder must provide an explanation of the interesting carotene-vitamin A-butter fat relationships in milk. Both carotene and vitamin A are present in milk in solution in the fat globules; but it has been shown quite recently that whereas the vitamin A-butter fat ratio is more or less independent of the size of the fat globule in milk, the carotene-fat ratio in the fat globule increases as the size of the globule diminishes, that is, as its relative surface area increases. This suggests that fat and vitamin A are synthesized, or perhaps one had better say assembled, by the same mechanism in the secreting cell, whereas the closely related (and also fat-soluble) carotene finds its way into milk by a different process associated in some unknown way with the *surface* of the fat globules.

All the water-soluble vitamins investigated—vitamin C, riboflavin and vitamin B_1—are considerably more concentrated in milk than in blood. Vitamin C is concentrated some eight times, riboflavin perhaps about four times, and total vitamin B_1 two or three times. All three are depressed in amount in mastitis milk, as would perhaps be expected since a function of the normal secretory cell is to take them up from the blood and concentrate them, a function which partially breaks down in the infected cell.

Energy Changes in Milk Secretion

Despite the rapid flow of blood through the mammary gland, a considerable proportion of the oxygen reaching the gland from the arterial blood is used up for combustion of one or more oxidizable substances in the tissue. Quantitatively, in some Shinfield experiments in which we were satisfied that the cows were undisturbed, the amount of oxygen used by the secreting gland was 4–5 volumes for each 100 volumes of blood, while at the same time 5–7 volumes of carbon dioxide were given out to the venous blood. The so-called respiratory quotient—volumes of carbon dioxide given out divided by volumes of oxygen used—was invariably higher than 1 in all experiments where the cows were undisturbed.

Similar findings have been made in at least two laboratories abroad, with both goats and cows; that is, in the undisturbed, normal animal, a mammary gland respiratory quotient of well above 1, usually between 1·1 and 1·3, is found.

If these findings are to be interpreted along the usual lines, it would mean that the secreting cells were synthesizing fat from carbohydrate. The American workers, who found that β-hydroxybutyric acid was being taken up from the blood by the gland, suggested that it was being partially oxidized and partially transformed into the short-chain fatty acids which occur specifically in milk fat. But it is known that the amount of blood *fat* taken up by the mammary gland is sufficient to account for all the milk fat secreted, so that this suggestion requires further evidence before it can be accepted.

Until we are fairly certain what substances are actually serving the gland as sources of energy and what blood precursors are transformed into milk constituents, exact knowledge of the energy changes in the gland will not be forthcoming, and it is probably idle to make any thermodynamic speculations at present.

Rate of Blood Flow through the Secreting Udder

One of the earliest estimates of the number of volumes of blood required, on the average, to produce one volume of milk, was made by the Shinfield workers in 1935, by comparing the fall in fatty acid, inorganic phosphorus and sugar between arterial and mammary venous blood. It was considered that probably between 400 and 500 volumes of blood must circulate through the udder to produce one volume of milk. This figure was little more than a guided guess, and it was pointed out at the time that implicit in this conclusion was the view that the lymphatic drainage of the udder could be regarded for the purpose of calculation as negligible—a likely assumption, but little more than an assumption. Afterwards, by use of a 'stromuhr' or volume-meter actually inserted in the circulation, Graham found that the blood flow was only about half our estimate. Still later findings of Shaw and others, who have used a rather different method of assessment, namely, by determining the amount of total calcium and total phosphorus taken, on the average, out of unit volume of blood by the udder, and the amount of the same materials in the milk secreted by the same animal during twenty-four hours, point again towards our original estimate of 400–500 volumes. Their average figure is given as 494 volumes of blood for each volume of milk—an average finding, of course, the lowest figure being 331 volumes for total phosphorus in one experiment and the highest 650 in one experiment for total calcium.

The results summarized in the accompanying table are probably not very far from the truth, though the experimental errors in the second column are quite appreciable, and also the efficiency of uptake of any blood precursor by the mammary cells will, like the efficiency of any other physiological process, undoubtedly vary from one cow to another and in the same cow at different stages in the lactation period and even at different times on the same day. It may nevertheless be concluded that, with a reasonably good cow at the peak of her lactation, giving say four gallons of milk a day, approximately nine tons of blood, say eighteen times her own weight, will pass through the udder each day.

TABLE 2. MAMMARY GLAND BALANCE. SUMMARY.

(From Shaw, Powell and Knodt, 1942.)

Blood precursor	Gland utilization per litre of blood (gm.)	Suggested end product				Ratio of blood volume to milk volume
		Milk substance	24 hr. production (gm.)	Blood required (litres)	Milk produced (litres)	
Calcium	0·0021	Calcium	22·52	10,931	19·40	563 : 1
Phosphorus	0·0021	Phosphorus	17·61	8,246	,,	425 : 1
Calcium +phosphorus	0·0042	Calcium +phosphorus	40·13	9,588	,,	494 . 1
Neutral fat	0·0684	Fat	707·5	10,817	,,	532 : 1
Glucose	0·1122	Lactose	985·5	9,070	,,	468 . 1

Precursors of Milk Constituents

To sum up, our present knowledge of th precursors of the main milk constituents is a follows :

Milk fat. This is almost certainly derived from the neutral fat of the blood. The short-chain fatt acids in milk fat are probably derived, as Hilditc first suggested, from the breakdown of some of th long-chain fatty acids in the blood fat, though th recent findings of Barcroft and his co-workers tha the ruminant is able to take up short-chain fatty acids direct from the rumen and that these ma circulate in the blood has to be borne in mind.

Lactose. This is almost certainly derived from the glucose of the circulating blood, though the latter sugar may pass, in part in any event, through intermediate stages such as lactic acid or even glycogen in the gland cells before being transformed into the lactose. Part of the lactose may come from the sugar-containing globulin which is taken up by the active gland cells from the blood.

Casein and lactalbumin. There is little doubt that amino-acids in the circulating blood contribute at least a little toward the synthesis of one or both of these proteins by the gland cells. Doubtless a major portion is contributed by the blood globulin which is now known to be taken up by the secreting tissue. Using radioactive phosphorus, it has been shown that the inorganic phosphate of the circulating blood provides the phosphorus organically combined in the casein molecule. We know less about protein synthesis by the gland than about fat and carbohydrate synthesis.

Energy. We know next to nothing as to what carbon compound is burnt in the mammary gland to provide the energy needed for synthesis of the milk constituents. It may be glucose, lactic acid, the sugar-containing moiety of the blood globulins just mentioned, or β-hydroxybutyric acid, or a part of the blood fat, or a combination of two or more of these.

In this connexion it seems more than likely that the secreting cells may be capable, like other tissues of the body, of using different materials for energy production or for milk production at different times and under different nutritional conditions. Although the secreting tissue of the mammary gland appears histologically to be simpler than that of, say, the kidney, it is clear from what has just been said that the activities of these large mammary cells are very complex. Their internal structural pattern and enzymic equipment are at present almost unknown.

CERVICO-FACIAL PIGMENTATION (MELANOSIS OF RIEHL-POIKILODERMA)*

By Dr. GEORGES GARNIER

Paris

Translator's Note. On a recent visit to Paris I was struck by the number of women suffering from diffuse pigmentation of the face. I saw my first cases in the streets and only learnt the nature of the condition when I visited the hospitals, where it is a commonplace in all dermatological clinics.

The melanosis of Riehl[1] is, to most British dermatologists, only a name, as it is a rarity in Great Britain as much in war-time as in peace. Its appearance in the War of 1914–18 and in this in starved populations seems more than mere coincidence, but the title 'war melanosis' given to the condition by Hoffmann and Habermann[2] has been challenged by Comel[3]. The condition is the subject of much discussion in France and there is great diversity of opinion as to its cause. Dietetic deficiency is not always obvious: the condition is seen in well-fed country dwellers as well as in city dwellers who have, on the whole, a very low dietetic intake. 'Nervous shock', so often invoked in conditions of unknown origin, has not been forgotten. Dr. A. Touraine, at the May meeting of the Société Française de Dermatologie et de Syphiligraphie, made a strong plea for the acceptance of the use of hair dyes as an important cause, but was just as strongly challenged by other members of the Society.

Dr. Georges Garnier's paper, which he has generously allowed me to translate, gives a well-balanced account of the various clinical and etiological aspects of cervico-facial pigmentation.

James Marshall.

THE obvious increase in incidence of cases of cervico-facial pigmentation directs attention again to this curious dermatological syndrome, which raises a series of clinical and etiological problems. Dermatologists describe the condition either under the name of melanosis of Riehl, the Viennese author who described it in 1917, or under the name of reticulate pigmentary poikiloderma of the face and neck, as described by Civatte in 1922[4]. For a certain number of authors these are two different conditions, closely related and almost completely identical histologically (Petges; Pierini and Bosq; Noguer More and Grau Barbera). For others (Civatte, Sézary), on the contrary, there is only one disease, or rather one single syndrome, in spite of the clinical differences to be described later. Until the last few years published observations have usually appeared under the title of reticulate pigmentary poikiloderma of the face and neck. More recently in France, Sézary, Jausion, Gougerot, Degos and Garnier have reported their observations under the title of melanosis of Riehl.

Whatever the term adopted, it must be recognized that it lumps together a number of features which may appear a little incongruous when one tries to detail the etiology and pathogenesis. There must first be distinguished groups where abnormal pigmentation is secondary to a pre-existing dermatosis. With R. Degos I described to the Society of Dermatologists in 1943 the case of a patient who presented clinical signs of poikiloderma (pigmentation and telangiectases) and who also had lichen planus. This dermatosis, so often productive of pigmentation, had assumed the appearance of reticulate cervico-facial melanosis. In studying earlier observations I have been struck to see how often lichen planus has been evoked or suspected in like cases, and where, in spite of a somewhat hesitant diagnosis, the publication carried the title of cervico-facial poikiloderma. There is a case described by Nomland[5] where Finnerud and Oliver do not accept the diagnosis and suspect a lichen. Similarly, Louste, Lévy-Franckel and Cailliau[6] describe a case where there were shiny papules with atrophic centres and a buccal leuco-keratosis, the condition being improved by 'Acetylarsan', a common therapeutic agent in lichen planus. In this connexion there can also be cited the observations of Gaté, Cuilleret and Bret[7], of F. Wise[8], and of Wiessenbach, Lévy-Franckel and Martineau[9]. It seems, therefore, that a certain number of cases described as reticulate pigmentary poikiloderma are in fact more or less typical cases of lichen planus and that this is a diagnosis which should be suspected more frequently.

Whatever they may be, these cervico-facial pigmentations present the following clinical picture: the patient, usually a woman, sees the progressive development of a pigmentation composed at first of isolated spots, soon becoming confluent into more or less extended patches on the forehead, temples, cheeks and lower eyelids and descending along the jaws to reach the sides and sometimes the nape of the neck. Usually the pigmentation stops one or two centimetres from the hair margin. In some cases an extension to the forearms has been described. The colour of the pigmentation varies from a deep greyish-brown through chocolate, sometimes reaching violet. It is disposed in irregular plaques with islands where the skin has kept its normal colour (notably around the pilo-sebaceous orifices), producing a reticulate aspect which sometimes suggests poikiloderma. However, there is usually lacking a symptom which is part of the classical triad of poikiloderma, namely, telangiectiasis. This is not mentioned by Riehl nor in most of the observations recently published in France under this name. Atrophy also may be lacking or may exist only in a most discrete fashion on certain regions, notably the temples. It must be admitted, however, that atrophy is not always easy to recognize clinically, and might be more frequently found on histological examination.

Such is the appearance in most cases of war melanosis of the type described by Riehl, and which corresponds to those recently observed. In the observations of Civatte and certain others there have been noted also the association of telangiectiases with reticulate pigmentation. Melanosis may extend to the arms and forearms, and certain authors have even noted patches of pigmentation on the buccal mucosa. Finally, one may see on certain patients special lesions, punctate blackish hyperkeratotic papules on the dorsa of the fingers, on the hands, and even on the forearms, resembling, when most marked, a follicular keratosis or pityriasis rubra pilaris, or even giving the appearance of oil acne. It is a question then of people working with tar derivatives, or with oils, the lesions being at maximum in the toxic lichenoid melanoderma of Hoffmann and Habermann in which hæmorrhagic bullae have been noted, and where there is a professional factor (tar workers).

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It is necessary in the consideration of the etiology of the condition to distinguish external and internal factors.

External Factors

Light has been invoked as a cause by numerous authors. It must be admitted that the localization of the melanosis on uncovered regions obliges us to take note of this. Light may act directly or in conjunction with a photo-sensitizing substance. In the case of direct action, the influence of light can be manifested by the appearance of an erythema which, more or less intense, sometimes precedes the appearance of pigmentation. Such was the case of one of the patients I recently described. This was a well-nourished woman of seventy years, in whom the melanoderma appeared after exposure to July sunshine which had caused intense redness of the face.

In other cases the action of light is exercised indirectly through the intermediary of a photo-sensitizing substance, which may act locally on the skin or be absorbed by the organism. The most important examples of the first type are tar and its derivatives, in which is found a fluorescent substance that is particularly photo-dynamic, acridine (Hoffmann). In the second type the sensitivity results from the respiratory or digestive absorption of the noxious substances (Kismeyer, Meyrovosky).

Other authors have blamed contact with lubricating oils (Thibierge); coal, in the case of an engine driver (Lortat-Jacob, Legrain and Cléret); creosote in railway sleepers, in the case of a platelayer (Hudelo, Cailliau, and Mornet); certain dye substances (Gougerot and Weil); cresyl (Garnier); and certain paints (Garnier). In a patient I saw recently I suspected hair dye as the cause. The dye involved was a substance of the chrysoidine type which gave no immediate cutaneous reaction but which sensitized the skin to ultra-violet light, as was shown by test. In this patient were associated both internal and external factors as, besides the action of the dye, there was a high porphyrinuria which further explained the photo-sensitization.

Internal Factors

These are many. Some cases show signs of visceral disease. Alcoholic liver damage was noted in numerous observations (Civatte, Lortat-Jacob, Sézary), and this would explain a porphyrinuria.

Other cases show endocrine disorders, notably ovarian (Civatte) and suprarenal (Sézary, Navarro-Martin and Aguilera). The role of the latter in pigmentogenesis is well known. The influence of the suprarenal must be investigated even if it does not appear to be the cause at first sight. I published in 1938[10] an observation on a woman with a typical melanosis of Riehl where cresyl might have been the cause, but who, a year later, died of Addison's disease. Sometimes it is the pituitary which is incriminated, but the influence of this gland is more difficult to decide.

We arrive finally at the elementary factors which, from the start, have been evoked by Riehl and which predominate in the pathogenesis of melanosis. It is striking to note that the first cases were observed in Central Europe, where the dietetic restrictions were particularly severe during the War of 1914–18, and that similar cases are now arising among our starved populations. Riehl at first suspected as the cause certain *ersatz* substances which were used in war-time bread (flour made from various leguminous plants). Hoffmann incriminated maize, others su pected margarine (Baschk) and barley (Kerl). A these products were capable of producing a phot sensitization analogous to that produced in pellag and in certain animal diseases (fagopyrism and tr foliosis). Avitaminoses must also be mentione notably deficiency of vitamin P.P. which is involve in the metabolism of the porphyrins. The role c porphyrinuria in the pathogenesis of the melanosis c Riehl is not considered important by some author (Petges, Jausion), while others take the opposit view. The quantity of urinary porphyrins, which i normally from twenty to forty gammas per litre, ma attain two hundred and eighty gammas (Garnier) and even sixteen hundred gammas in a case describe by Degos and Carrot[11] in a prisoner-of-war whos pigmentation improved after his return to mor normal diet.

Vitamin C deficiency may also be a cause. Moravit has suggested that it has a part in the pigmentatior of Addison's disease. One of my patients presented a marked diminution of urinary ascorbic acid and was much improved after administration of vitamin C.

To summarize, it is necessary to consider cervico-facial melanosis as a syndrome which can arise from different causes. Some are external, for example, (1) light; (2) tar products acting as photo-sensitizers; (3) direct action of toxic products on the skin. Others are internal, for example, (1) visceral and endocrine deficiencies; (2) disorders of porphyrin metabolism; (3) avitaminoses. The pathogenesis of the cervico-facial pigmentations is most complex, as all these causes may act alone or, oftener, in association.

From the clinical point of view it is difficult to classify the cervico-facial melanosis syndrome. Abroad, numerous authors (Kinnear, Noguer More, Grau Barbera, Pierini and Bosq) distinguish: (1) Melanosis of Riehl, a pure pigmentation in which is lacking clinical evidence of telangiectases and atrophy and in which contact with external factors is a part of the history. (The toxic lichenoid melanoderma of Hoffmann is classed only as a particularly intense variety in which professional causes preponderate.) (2) The reticulate pigmentary cervico-facial poikiloderma of Civatte in which the melanosis is associated with telangiectases and atrophy. This variety is classed as a localized form of the poikiloderma of the type described by Petges and Jacoby. Internal factors, notably endocrine, predominate, and external causes blamed in the melanosis of Riehl are not found.

In reality, these differentiations are more academic than real. Many of the clinical characteristics invoked to distinguish these two groups are disputable. The pathogenic factors, external in the melanosis of Riehl, internal in the cervical-facial poikiloderma of Civatte, are alike insufficient to draw exact limits. We have seen that Riehl himself suggested a dietetic cause for the melanosis he described, and is it not possible in a cervico-facial poikiloderma lacking external causes at least to admit the possibility of light being a factor and adding its action to visceral and endocrine disorders? On the other hand, it seems to me necessary to set aside a group of cervico-facial melanoses in which the pigmentation is secondary to a pre-existing dermatosis, often undiagnosed, in particular, lichen planus.

Treatment

By its slow persistent evolution on the face and neck it constitutes for patients an æsthetic trauma which, in certain women, can lead to a veritable obsession. It is important, therefore, to apply treatment which, though it cannot be rapidly effective, will at least retard the extension of the disease and hasten its regression. Locally, the bleaching lotions normally used are without effect. It is necessary to avoid injury by light and to prescribe an anti-actinic cream containing 6 per cent of menthyl salicylate. The handling of noxious substances, tar and its derivatives, dyestuffs or paints must be stopped. In certain cases one must compensate endocrine deficiencies (ovary and suprarenal particularly). Finally, one must counteract the various vitamin deficiencies, in particular of vitamin P.P. and vitamin C. It is necessary to give a high dosage of nicotinamide (0·6 gm. per day at least, by mouth) and to add, if deficiency of vitamin C is suspected or proved, ascorbic acid (0·3 gm. per day at least).

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[1] Riehl, *Wien. klin. Wschr*, 30, 780 (1917).

[2] Hoffmann and Habermann, *Deutsche med. wschr.*, 44, 261 (1918).

[3] Comel, *Gior. ital. de derm. et sif.* (June 1933).

[4] Civatte, *Ann. de derm. et syph.*, 4, 605 (1923).

[5] Nomland, *Arch. of Derm and Syph.*, 22, 184 (1930).

[6] Louste, Lévy-Franckel and Cailliau, *Bull. Soc. derm. et syph.*, 679 (1932).

[7] Gaté, Cuilleret and Bret, *Bull. Soc. derm. et syph.*, 583 (1934).

[8] Wise, *Arch. of Derm. and Syph.*, 587 (1934).

[9] Wiessenbach, Lévy-Franckel and Martineau, *Bull. Soc. derm. et syph.*, 574 (1935).

[10] Garnier, *Bull. Soc. derm. et syph.*, 900 (1938).

[11] Degos and Carrot, *Soc. franç. de derm. et syph.* (Dec. 1942).

NEWS and VIEWS

Prof. L. Bairstow, C.B.E., F.R.S.

THE retirement of Prof. L. Bairstow from the post of Zaharoff professor of aeronautics in the University of London marks the departure of a pioneer from the scientific side of aviation. Bairstow began his work on aerodynamics so long ago as 1909. He was then on the scientific staff of the Engineering Department of the National Physical Laboratory, and when it was decided to undertake aerodynamic research in the Laboratory, he was charged with the formation of a small group of workers and the carrying out of research under the general control of the Advisory Committee for Aeronautics. He very quickly justified the confidence placed in him and began to lay the foundations of the new science. Seeing at once the fundamental importance to aerodynamics of the theory of dynamic similarity, he initiated experiments in air and water to prove its truth to the unbelieving. By 1911, he and his collaborators had made a number of investigations on wind tunnel design and had succeeded in producing what was the first really satisfactory wind tunnel in Britain. About the same time he was studying the theory of the stability of aeroplanes, as laid down by Bryan, which he extended very greatly as time went on and generalized to cover all six degrees of freedom. He employed the wind tunnel to measure aerodynamic stability derivatives, and by using the values so obtained in the light of the theory, he produced the first clear account of the disturbed motions of aircraft, and established the fundamental basis of all later developments in this field. He even traced the motion of an aeroplane as it flew through a prescribed gust. An example of his experimental versatility was an attempt to investigate the motions of airships by tests on models about six inches long in a water stream flowing at a few inches a second! He was responsible for the first investigation in Britain on the subject of flutter, and he contributed much to the knowledge of practical flying by his investigations of flying accidents. The Aerodynamics Division of the National Physical Laboratory, as it exists to-day, owes Prof. Bairstow an immense debt of gratitude for the work he did in establishing it. This work was recognized in 1917 by the award of the C.B.E., and by his election to the fellowship of the Royal Society.

Prof. Bairstow was the first superintendent when aerodynamics became a separate Department of the National Physical Laboratory, but he left in June 1917 and took up duties at the Air Ministry. In 1920 he became professor of aerodynamics under Sir Richard Glazebrook, who then held the Zaharoff chair at the Imperial College, London. He succeeded to this chair in 1923 and has held it ever since, thus spending a large part of his life in guiding the destinies of students in the College where he himself had been educated. He became Dean of the Faculty of Engineering at London in 1935, and was appointed to the Senate in 1936. The excellence of his work at the University is well shown by the number of his students who to-day occupy important positions in industry and in the Government research institutions. Prof. Bairstow was also very active outside the University. He was vice-president of the Royal Aeronautical Society during 1930–34, but his greatest contribution, apart from his research and teaching, was his service on the Aeronautical Research Committee, of which he has been vice-chairman for many years, besides occupying the chair of several of its important subcommittees. His book, "Applied Aerodynamics", is almost a classic, and is by far the most comprehensive work on the subject by an Englishman. To those who have known him intimately, Bairstow has always been ready with counsel and advice, and has endeared himself to his many friends by his delightful personality and charm. Though he deserves a well-earned rest after a long life's work, it is to be hoped that he will still be able to spare a little of his time to help forward the great advance of aeronautics which the future appears to hold in store.

Museums and the Community

THE case for the museum in relation to modern educational and cultural developments is well and fairly examined in Part 1 of a 39-page pamphlet entitled "New Zealand Museums" by Dr. W. R. B. Oliver (Dominion Museum, Wellington, 1944). The subjects of research, display of exhibits, reference collections, buildings, policy and administration are fully reviewed, but those sections dealing with education are worthy, perhaps, of particular attention. In reference to adult education, Dr. Oliver writes: "The kind of information distributed through the Museum services is not limited to a few subjects such as biology, ethnology and geology. . . . Those subjects not dealt with in the exhibition galleries can be covered very effectively and thoroughly by films shown during the regular educational screenings. By means of films and authoritative lectures, the Museum can extend its province to cover the entire range of human knowledge." This is a fine conception of the work lying within the grasp of the larger museums, but its fulfilment, both in Great Britain and elsewhere, would seem to require closer co-operation between the museums, all other kinds of educational institutions, scientific and art societies, and individual specialists than has generally been the case hitherto. Only when the work of each is mutually understood and appreciated will the museum be able to establish itself fully as the link between the research worker and specialist, who continually advance our knowledge, and the ordinary men and women, who need to be kept informed of such advances.

With regard to school services an interesting development in the Dominion Museum is well worth attention. Before the War, this Museum provided regular instruction for visiting classes of schoolchildren. On each visit the children were first given a lecture—usually illustrated by a film—in the lecture hall. There then followed a lesson in the Museum. Here the children were divided into groups, each of which was under the charge and instruction of a student teacher from the training college. Six teachers at a time attended the Museum for this purpose for a period of six weeks, and in this way gained valuable experience in the use of museum material. They, themselves, were instructed by members of the Museum's professional staff, and so, ". . . the value of the museum to the community was emphasized to the students, who left the institution with sufficient knowledge of its capabilities and functions to enable them to educate their future charges in the purposeful use of the public museums". Part 2 of this valuable pamphlet deals more particularly with the present buildings, administration, equipment, finance, etc., of New Zealand museums.

Belgian Biological Publications during the War

Dr. Julian Huxley has received a letter from Prof. C. J. Van der Klaauw, of the Department of Zoology of the University of Leyden, and one of the directors of *Acta-*, *Folia-*, *Bibliographia-*, *Bibliotheca-Biotheoretica*. Prof. Van der Klaauw states that he is well, as is also his lecturer in experimental zoology, Dr. N. Tinbergen, although both of them spent some two years in a concentration camp, with about twenty of their colleagues from Leyden. After release from imprisonment, Prof. Van der Klaauw was exiled to the eastern part of Belgium. He adds that Prof. H. J. Jordan, professor of comparative physiology in the University of Utrecht, died of apoplexy during the War.

During the occupation of Belgium, vigorous efforts were made—with a considerable measure of success—to keep alive the biological journals referred to above, and to maintain their international character. Since May 1940, the last two parts of vol. 5 of *Acta Biotheoretica* have appeared. They contain a paper by a German (Frieling), three by writers in the United States (Rashevsky, Lafleur) and one by a Russian in France (Kostitzin, in French). Vol. 6 appeared in 1942, containing four papers in German (Friederichs, Hofstaetter, Kuhn, Meyer-Abich), two by a Pole (Wilzýnsky, in English and French), and one by a Dutchman (Ariëns Kappers, in English). Vol. 7 appeared in 1943 and contains three papers in German (Meyer-Abich, Friederichs, Thienemann), one by a Norwegian (Ubisch, in German), three by Dutchmen (Voûte, Raven, Pos ; two of them in French, one in English) ; two papers by a Pole (Wilzýnsky, in English). Another paper by Wilzýnsky (in English) and one by a Dutchman (Baas Becking, in English) will fill part of the next volum The series entitled *Bibliotheca Biotheoretica* start during the War. There have appeared : No. 1 (194 a paper by Prof. H. J. Jordan, in German ; No. (1942), a rather long paper in German by a Russi (Schaxel) ; No. 3 (1942), a long paper in English Dr. N. Tinbergen ; No. 4 (1944), a long paper English by two Dutchmen (Booy and Wolvekamp In the series *Bibliographia Biotheoretica* the appeared : Vol. 2 (literature 1930–34) in 1941, th last part of Vol. 3 (1935–39) in 1942, and in 1944 th first part (82 pp.) of the fourth volume (literatu 1940–44).

Prof. Van der Klaauw and his colleagues hav clearly done their best to maintain the internation scope of the periodicals produced by the Prof. D Jan Van der Hoeven-Stichting. They hope th British scientific workers will use their journals in th future.

Historical Background of Planning

In Occasional Pamphlet No. 1 issued by th Society for Freedom in Science (April 1945. 1*s*. 6*d*. under the title "Is the Progress of Science Controlle by the Material Wants of Man ?", Dr. F. Sherwoo Taylor makes a spirited attack on the main thes of a memorandum issued by the Association of Scien tific Workers in November 1943 on "The Develop ment of Science". Dr. Taylor challenges the historica arguments advanced in that memorandum in favou of the planning of science and, apart altogether fron the question whether or not those arguments ar justly inferred from true historical data, Dr. Taylor' pamphlet is to be welcomed as a corrective to an undoubted tendency to mix propaganda and history. It should stimulate clearer thinking about the development of science: science, he reminds us, is something done by people, and if it is organized at all, it is organized by people. He urges that no causes should be looked for outside the internal logic of science, until those within it have been exhausted. Listing the great discoveries of the years 1775–1800, he considers that only Watt's improvements in the steam engine, Cort's puddling of iron and Jenner's vaccination can be said to be dictated by human needs ; and similarly, while applied science workers are concerned to bring the discoveries in pure science into rapid use, the great discoveries of the last fifty years were not dictated by human needs. Simply from the point of view of causing discoveries to be made, the community must take a long-term view and encourage science to advance in its own way.

Dr. Taylor frankly challenges the practicability of planning pure science, even by men of science ; let the community plan applied science if it can, he says. If any planning or direction of funds has to be done, let the planning and direction be on the basis of the maximum increase of research directed to knowledge and irrespective of use. But while he rightly argues that to ensure the maximum of scientific research will give the maximum useful rewards to the whole world, he passes over the fact that resources are limited, that the research front is uneven and advance in some fields is retarded by neglect elsewhere. So, too, while he is right to urge the reading of the works of the great men of science instead of modern books advancing not wholly uncoloured views about them—advice which might well be heeded by many scientific workers, apart from the public, who would thus be better able to understand the nature of the scientific man and his methods—he is just a little too sweeping in his condemnation of the reading list provided in the A.S.W. pamphlet, and he might have strengthened his case by a reference to the "Source Books in the History of Sciences" published by the McGraw-Hill Book Co., which within their limits overcome the difficulty of accessibility to which Dr. Taylor refers.

Colonial Geological Surveys of Africa

SIR EDMUND TEALE's important address on "The Contribution of Colonial Geological Survey to the Development of the Mineral and other Resources of East and West Africa", delivered before the Royal Society of Arts, is published in the Society's *Journal* of April 13, 1945, pp. 245–56. The success of the early mineral surveys, of which the first was started n Nigeria in 1903, made it clear that larger staffs and fuller facilities for the wide extension of geological work on more systematic lines would be amply ustified. The first permanent Geological Survey was started on the Gold Coast in 1910, to be followed in 1918 by one in Nigeria, and later by others in Uganda, Tanganyika, Nyasaland, Sierra Leone and Kenya. Their economic activities are summarized as (*a*) *exploratory*: dealing essentially with investigations which yield results in the actual discovery of new deposits of minerals, or in mapping the geological features which assist prospectors or mining engineers to locate and open up mineral occurrences; and (*b*) *advisory*: including numerous forms of assistance regarding engineering, industrial, commercial, agricultural and welfare interests (for example, water supply, soil conservation and site locations). Much of this assistance, though it has far-reaching influence on colonial development, does not usually lend itself to statistical valuation.

On the exploratory side, however, actual mineral discoveries by Survey geologists have yielded direct revenue in royalties alone which have repaid many times over the total cost of all the Colonial Geological Surveys. The cumulative values of some of the more important Survey discoveries are as follows (up to 1939 or 1940):

Gold Coast	Diamonds	£7,618,186
	Manganese ore	10,062,594
Sierra Leone	Iron ore	2,640,966
	Diamonds	4,700,272
Nigeria	Coal	1,860,000

Certain other minerals, such as mica, tin and tungsten ores, and above all bauxite (of which the estimated reserves are 250 million tons in the Gold Coast and 60 million tons in Nyasaland), have afforded important supplies to the strategic mineral requirements of the War.

High Polymer Bulletin

ANYONE familiar with present developments on the academic side of micro-molecular chemistry and physics cannot fail to be impressed by the contributions made to the subject by Prof. H. Mark, now of the Polytechnic Institute, Brooklyn, New York. In this Institute there has been established a Bureau of High-Polymer Research, the business of which is to carry out research on all problems of high-polymer chemistry and to organize and to conduct courses of instruction and also discussions on various aspects of the subject. In order to let the scientific public know more about the activities of the Bureau than would be gleaned by reading papers in the scientific journals, a *Polymer Bulletin*, issued bi-monthly, has made its appearance under the editorship of Paul M. Doty. The first number gives a brief description of some of the equipment of the laboratory and of the researches now in progress, but not yet published in the usual journals. While this preview of what is to come from the laboratory is of great interest to high-polymer chemists, it is somewhat unusual, and incidentally an interesting experiment, to find an academic laboratory publishing its own 'science news'. Thus yet another publication is added to the list which a busy investigator must scan to make sure that his own work is not likely to be out of date before it is published. In a quickly advancing subject like high polymers, at the present stage the desire to found new journals inevitably arises; the measure of success depends upon what support is given to the venture in its initial stages.

The World To-day

WITH its last issue, for June 23, the *Bulletin of International News* has been replaced by a monthly review, *The World To-day*, and a *Chronology of International Events and Documents* appearing twice monthly. Each issue of the former will contain "Notes of the Month" and five or six articles. The first issue for July includes five, dealing with the municipal elections in France, the Allied zones of occupation in Germany, Germany and European reconstruction, international air transport and Guernsey under German occupation. It is hoped that by articles giving factual background to current international problems and first-hand accounts of conditions in foreign countries, *The World To-day* will help to meet the demand of the general reader for such factual information; while the Supplement will be for the specialist who requires the reference material in connexion with his work as a student of international affairs, lecturer or writer, business man or diplomat. The new arrangement will also permit the most economical use of the available paper.

Energy Regulators

THE energy regulator made available by Sunvic Controls, Ltd., operates by periodically switching the power on and off, the ratio on-time/total time determining the average power input. The regulator is generally cheaper and far less bulky than a variable resistance. The control is effected without the energy loss in a resistance, it is variable continuously from no load to full load, and is substantially independent of mains voltage fluctuations up to about 20 per cent. Two forms are available, one for industrial purposes having a minimum time-cycle of about 30 sec., and another for laboratory use with a cycle of about 10 sec. The regulator consists essentially of a bimetal strip carrying a heater winding, connected in parallel with the load to be controlled. A snap action switch is in series with the load and is normally closed, so that current flows through the heater winding and through the load. The bimetal warms up and, in bending, opens the switch, interrupting the current both to the heater winding and the load. The bimetal then cools down and the cycle is repeated. The ratio of the time during which the contacts are made to the total time of the cycle determines the average input.

Some applications of the regulator are as follows: (1) in apparatus where it is inconvenient or impossible to fit a thermostat—for example, hot plates, injection moulding nozzles, moulding platens, etc.; (2) for small, high-temperature ovens and furnaces where the cost of temperature control would be excessive; (3) for any heating process where the temperature is a function of power input only; (4) to control the rate of change of temperature in a furnace in order to reduce the temperature differential permitted by conventional temperature controllers; (5) for controlling the input to a furnace so as to obtain rapid heating-up without undue over-run at the operating temperature; (6) to control the average output of a motor driving, for example, a conveyor or pump where there is no objection to the motor being periodically started and stopped, such as a pump filling a tank or a motor driving an automatic stoker or a belt travelling through a furnace. The regulator can also be employed to obtain an adjustable time delay of 10–120 sec. and as a flasher with adjustable on/off ratio.

Future of Electricity Supply in Matabeleland

A PAPER on this subject is contributed by Mr. A. R. Sibson to the February 1945 issue of the *Journal of the Institution of Electrical Engineers* (92, Pt. 2, No. 25). Southern Rhodesia is now coming to life industrially, and the problems of electricity supply require careful consideration if the Colony is to progress on sound economic lines. In this paper, the existing economic and geographical conditions are first outlined, together with the sources of raw materials, power and water. The probable development of basic industries in Matabeleland is discussed and other possible avenues of electricity consumption are detailed, including railway traction and the natural growth of existing load centres. The author then investigates three different methods of supplying the power demand of the future, two of which involve the transmission of large blocks of power over distances in excess of two hundred miles. The peculiar problems inherent in long-distance transmission in Rhodesia are dealt with, and the economics of overhead lines operating at 250 kV. are examined. The author reaches the final conclusion that the use of hydro-electric power, up to a total of 100,000 kW., from the Victoria Falls should be seriously considered as part of a comprehensive scheme for future supplies.

Insecticides

SOME useful information about the phytopathological uses of the new insecticide D.D.T. (dichlorodiphenyl trichlorethane) has been given by H. Martin and R. L. Wain (*J. Roy. Hort. Soc.*, 69, Pt. 12, Dec. 1944). This substance, at insecticidal strength, is harmless to man and farm animals, but acts both as a contact and stomach poison to insects. D.D.T. could probably replace lead arsenate in the combined spray with lime sulphur, without any objectionable sludge of lead sulphide. Perhaps its most outstanding possibility, however, is its use as a persistent contact insecticide. It is unaffected by light and moisture, in contrast to the pyrethrins and rotenone, and offers the horticultural possibility of applying a contact insecticide at any convenient period—not, as hitherto, when the insects are actually exposed upon the plant. This should provide a useful method of control for such pests as apple blossom weevil and the leaf miners, which are usually protected from any direct spray, but move about the plant for certain limited periods. D.D.T. does not seem to have any egg-destroying properties, and is somewhat slow in action, but these defects are small in comparison with the positive benefits. A short anonymous account following the above reference directs attention to a new thiocyanate winter wash. The toxic agent β-butoxy-β′-thiocyanodiethyl ether, and this is i corporated with petroleum oil. Thiocyanate wash are non-poisonous to human beings, domestic anima and poultry, are more convenient in use than d nitro-*ortho*-cresol (D.N.C.) and give a good contr of woolly aphis, which has hitherto eluded a attempts to control it by spraying.

Palæontographical Society's Centenary, 1947

THE Council of the Palæontographical Society h accepted a recommendation from its Centenary Con mittee urging the publication of a directory of Britis fossiliferous localities. The object of the scheme to produce a small handbook from which any perso interested in fossils can ascertain where particul formations and assemblages of fossils can be co veniently studied, and where in any district there a reasonable chance of collecting typical fossil. Institutions and persons known to have an intere in geology will be circularized and their co-operatio sought in supplying data about useful localities i their respective districts. Offers of help from anyon with precise and recent knowledge of fossiliferou localities will be cordially welcomed. Further detail may be obtained from Mr. R. V. Melville, Palæontographical Society, c/o Geological Survey and Museum Exhibition Road, London, S.W.7.

Display and Bower Building in Bower Birds

MR. E. NUBLING, Normanhurst, N.S.W., ha written with reference to the paragraphs under thi heading in *Nature* of January 27, 1945, p. 105. Thes notes were intended as an acknowledgment and condensed version of a very long communication submitted by Mr. Nubling for which space could not b found in *Nature*. We regret that in preparin this abstract a mistake was made: the remark o the whole proceeding of courtship and nidificatio occurring during decreasing light refers to the lyre bird, not to the satin bower-bird as stated there.

Parliamentary Representatives of the Universities

THE following have been elected members of Parliament, to represent the Universities of Great Britain and Northern Ireland: *Oxford:* Sir Arthur Salter and Mr. A. P. Herbert; *Cambridge:* Mr. K. Pickthorn and Mr. H. Wilson Harris; *London:* Sir E. Graham-Little; *Wales:* Prof. W. J. Gruffydd; *Queen's, Belfast:* Prof. D. L. Savory; *Combined English Universities:* Miss Eleanor Rathbone and Mr. Kenneth Lindsay; *Scottish Universities:* Sir John Anderson, Sir John Orr and Sir John Graham Kerr.

Announcements

THE Lord President of the Council has appointed Dr. W. F. P. McLintock to be director of the Geological Survey of Great Britain and Museum of Practical Geology; Dr. McLintock has been deputy director since 1937.

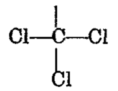
THE Ministry of Supply has agreed to the release of Dr. H. J. Gough, chief scientific officer to the Ministry. The University of Cambridge has consented to continue the loan to the Ministry of Prof. J. E. Lennard-Jones, who has been appointed chief scientific officer in succession to Dr. Gough. Prof. Lennard-Jones has been chief superintendent of the Armaments Research Department, Ministry of Supply, since 1942.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

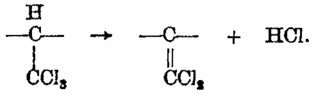
Insecticidal Action of D.D.T.

THE remarkable insecticidal powers of the compound D.D.T. (alpha alpha *bis*-(4-chlorphenyl)-beta beta beta trichlorethane) have attracted some attention for their theoretical interest as well as for their practical utilization. Two quite independent hypotheses concerning its outstanding toxicity have been published so far. They are alike in ascribing it to a combination of a toxic component of the molecule with a grouping conferring lipoid solubility; but here they part company. Dr. Läuger[1] and his colleagues believe that the toxic component is the linked *p*-chlorbenzene rings, on the grounds that they have found several compounds of this type toxic to insects when ingested. They infer that the group



$$\begin{array}{c} | \\ \mathrm{Cl-C-Cl} \\ | \\ \mathrm{Cl} \end{array}$$

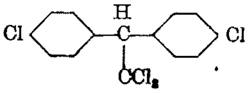
(cf. chloroform) imparts lipoid solubility. Dr. Hubert Martin[2], on the contrary, suggests that it is the chlorbenzene rings which confer lipoid solubility and that the remainder of the molecule is responsible for toxicity, by splitting off hydrochloric acid at the vital centres, thus:



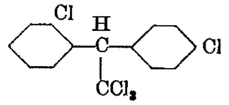
$$\begin{array}{ccccc} \mathrm{H} & & & & \\ -\mathrm{C}- & \rightarrow & -\mathrm{C}- & + & \mathrm{HCl.} \\ | & & \| & & \\ \mathrm{CCl_3} & & \mathrm{CCl_2} & & \end{array}$$

In the past year, an investigation of the toxicity of D.D.T. and a number of analogous compounds has been made in this Laboratory. The results have been considered in relation to the above theories but cannot be simply explained by either of them. The compounds most carefully examined were the following:

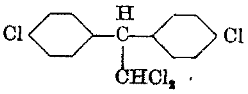
I. D.D.T. (*para para*)



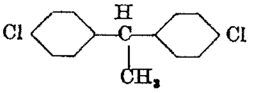
II. *iso*-D.D.T. (*ortho para*)



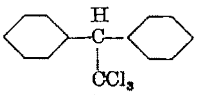
III. Dichlor diphenyl dichlorethane



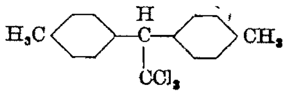
IV. Dichlor diphenyl ethane



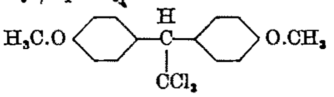
V. Diphenyl trichlorethane



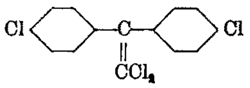
VI. Dimethyl diphenyl trichlorethane



VII. Dimethoxy diphenyl trichlorethane



VIII. Dichlor diphenyl dichlorethylene



Toxicity to Insects. Figures giving the relative toxicity of the samples were obtained for the body louse (*Pediculus humanus*) and the bed bug (*Cimex lectularius*). The samples were dissolved in refined white oil and sprayed directly on to the insects in the tower designed by Potter[3]. Concentration-mortality relations were determined by keeping the deposit constant (at 0·36 mgm. per sq. cm.) and varying concentrations. The results were plotted as log. concentration-probit regression lines, and median lethal concentrations taken from them are given in the accompanying table.

It will be observed that the relative toxicity of the various analogues is fairly similar for the two test insects. This fact, together with the evident similarity in the symptoms produced by the more toxic samples (continuous unco-ordinated activity), suggests that their mode of action is similar. The comparatively high toxicity of dimethoxy diphenyl trichlorethane (VII), especially to *Cimex*, is noteworthy. Dr. Läuger makes no attempt to explain this.

Ease of hydrolysis. The various samples were hydrolysed as 0·008 molar solutions in methyl alcohol, using $N/20$ caustic potash, at 18–20° C. The relative speeds of hydrolysis are indicated in the table by the percentages of molecules from which HCl has been split off after 240 minutes.

It is interesting to find that D.D.T. (I) is most rapidly hydrolysed under these conditions. But the dimethoxy compound (VII) remains an exception; its low speed of hydrolysis is not commensurate with its high toxicity.

Lipoid solubility. Both the theories which have been mentioned make reference to lipoid solubility, but there seems to be no actual evidence of the lipoid solubility of the complete compounds.

In order to form an impression of the lipoid solubility of the various analogues, some approximate measurements were made of their solubility in olive oil and white oil (rather similar to liquid paraffin). The results are shown in the table in comparison with the median lethal concentrations to lice and bugs.

From this table there is no evidence that the most toxic analogues are most compatible with lipoids: indeed there is a suggestion of an inverse relationship. A partial explanation of this situation was sought on the lines suggested by Ferguson[4] for various narcotic poisons. As an approximation to Ferguson's 'chemical potentials', the relative degree of saturation of the substances in the carrier liquid and hence in the phases in contact with it (cuticle waxes and lipoids) may be considered. Since the more toxic compounds are least soluble, *some* of the differences in toxicity should disappear if the insects are exposed to dry films or saturated solutions. Experiments with lice, however, gave no indication of this. The insects were confined for various periods on filter papers impregnated with saturated solutions of the compounds in white oil. The times necessary for

Sample	Toxicity : (M.L Conc.) Lice	Bugs	Hydrolysis : (% hydrolysed after 240 min.)	Solubility : (w/v% at 18° C.) Olive oil	White oil
I D D T. (*para para*)	0·3	0·53	100	10	2–3
VII Dimethoxy diphenyl trichlorethane	0 9	0 55	10	8–10	1–2
III Dichlor diphenyl dichlorethane	0 9	1 2	33	10	1–2
VI Dimethyl diphenyl trichlorethane	1 7	3·6	8	18–20	6–8
II *iso*-D.D.T. (*ortho para*)	5 5	>20	13	25	10–14
V Diphenyl trichlorethane	7·5	,,	10	25–30	10–12
IV Dichlor diphenyl ethane	8·5	,,	—	30	25
VIII Dichlor diphenyl dichlorethylene	>20	,,	—	14–18	8–10

50 per cent of the lice to pick up a lethal dose of the different substances were as widely dispersed as the median lethal concentrations, and the compounds showed the same order of toxicity.

The general conclusion to be drawn from the data presented here seems to be that, at present, there is insufficient data to formulate a theory of the action of D.D.T. Some attempts to support current hypotheses with quantitative data have met with no success. Of particular interest is the low toxicity of the *ortho-para* D.D.T. and the fairly high toxicity of the dimethoxy compound. It seems possible that the shape and size of the molecule are important.

I am indebted to Prof. P. A. Buxton for reading and criticizing this account and to Dr. J. H. Birkinshaw for suggesting the method of hydrolysis. Most of the samples were prepared at the Chemical Defence Experimental Station of the Ministry of Supply, but Nos. V and VI were made by Dr. J. G. Mitchell of the D.S.I.R. Chemical Research Laboratory.

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[1] Läuger, P., Martin, H., and Muller, P., *Helv Acta Ch m*, **27**, 892 (1944).

[2] Martin, H., and Wain, R. L., *Nature*, **154**, 512 (1944).

[3] Potter, C., *Ann. Appl Biol.*, **28**, 142 (1941).

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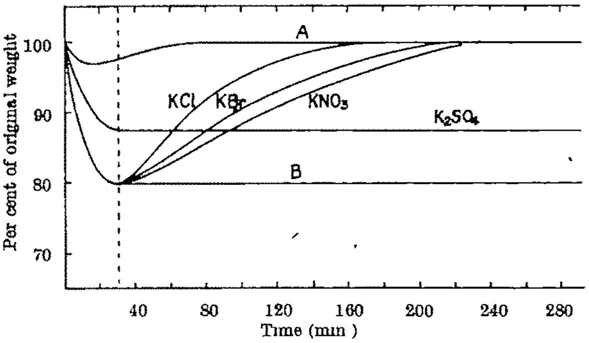
Cation and Anion Permeability Constants for the Muscle Fibre Membrane

THE following simple experiments allow of first approximate determinations of permeability constants of salts of potassium, rubidium and cæsium across the muscle membrane of the frog's sartorius. (As will be shown later, ammonium salts are unexpected in their behaviour.)

When weighed sartorius muscles of frogs are immersed at room temperature in Ringer fluid containing 110 m.eq. sodium chloride per litre plus 30 m.eq. potassium chloride (to prevent K loss) and a small addition of phosphate for buffering (about $M/500$), pH = 7·0, curve *A* is obtained for the mean muscle weight, relative to the fresh weight. After a slight fall and return (due to potassium chloride it remains steady over some hours. Throughou the immersions the muscles were stirred by bubbling with oxygen, and they are removed for weighing from time to time. If such Ringer fluid contained 21 m.eq. sodium chloride instead of 110 m.eq., curve *B* is obtained, parallel with *A* after 20–30 minutes.

When, after reaching a steady weight along the *B* curve, the muscles are removed into a simila Ringer fluid in which 100 m.eq. potassium chloride have been substituted for 100 m.eq. sodium chloride, there is a return to the normal level as shown in the graph. If the chlorine ions are replaced throughout by bromide or nitrate, the corresponding curves shown in the graph are obtained. The graph likewise shows the effect of the sulphate ion substitution (in equivalent concentration throughout).



Such experiments show very clearly (what has otherwise been fully demonstrated for potassium and chlorine ions) that the muscle membrane is permeable to potassium, chlorine, bromine and nitrate ions, also to rubidium and cæsium ions, but not to sodium and sulphate ions. Assuming that the form of the potassium chloride curve in the graph is determined solely by the entrance of potassium chloride, the entrance of water being much faster, we can write:

$$dQ/dt = D \times \frac{(C_0 - C_1)}{l_m} \times \text{surface}, \quad . \quad . \quad (1)$$

or, the rate of penetration is proportional to the gradient of concentration across the membrane multiplied by the surface and a membrane diffusion constant *D*.

Integrating this equation, it may be noted that potassium chloride outside will diffuse into the fibres, so that the concentration then added is approximately equal to the external value[1]. Hence it follows that

$$2{\cdot}3 \log C_0/(C_0 - C_1) = \frac{D}{l_m} \times t \times \frac{\text{surface}}{V}, \quad . \quad (2)$$

where C_0 is the external concentration, and C_1 the concentration of the added potassium chloride. Putting in the *t* value as that when the process is half advanced, the equation may be written

$$P = D/l_m = 0{\cdot}276\, r/t_{0\cdot5} \quad . \quad . \quad . \quad (3)$$

This value of *P*, or permeability constant (as used by Jacobs and others[3]), gives the diffusion rate per unit surface per unit concentration difference across the membrane (dimensions = L/T). When the unit of length is taken as μ and the mean value of *r* for the sartorius muscle fibre as 20 μ, then

$$P = 5{\cdot}5/t_{0\cdot5} \quad . \quad . \quad . \quad . \quad (4)$$

Inserting the values of $t_{0\cdot5}$ in minutes for potassium chloride, etc., we get for the values of *P* at 15° C.:

$KCl = 0{\cdot}12$ $RbCl = 0{\cdot}04$
$KBr = 0{\cdot}08$ $CsCl = 0{\cdot}01$
$KNO_3 = 0{\cdot}06$

hen the unit of concentration difference across the embrane is referred to a volume of one litre, these alues are multiplied by 10^{-15}, and when the second used as the unit of time instead of the minute, ey are multiplied by $10^{-15}/60$.

Besides the usual approximations involved in the etermination of permeability constants, which involve but little error, the following arises. It is sumed that no appreciable error is introduced by noring the time to reach equality of concentration the muscle interspaces and the external solution. nce the half-value period for the first part of the urve *B* is only about five minutes, it is clear that no rious error arises from this source, the value for otassium chloride as given being at most depressed y 12 per cent, and for the other salts in much lesser mounts.

If we are to attach a meaning to the permeability onstants of the separate cation and anion species in ese experiments, then it will appear that the rates or potassium and chlorine ions must each be either qual to or greater than the potassium chloride value, nd also that the figures for the single ion species, romide, nitrate, cæsium and rubidium, are near he values given for the corresponding salts.

Such figures for the permeability constants are t present being further refined upon. The experiments include studies of single fibres from the semi-tendinosus muscle of the frog.

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P. T. MOORE.

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University College,
Dublin.
May 6.

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[1] Boyle, P. J., and Conway, E. J., *J. Physiol.*, 100, 1 (1941).

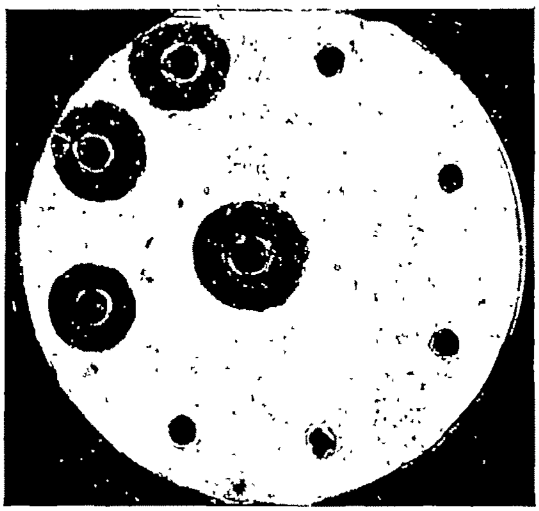
[2] Davson, H., and Danielli, J. F., "The Permeability of Natural Membranes" (Camb. Univ. Press, 1943).

Anti-bacterial Action of 'Polyporin' against Typhoid, Cholera, Dysentery and *B. coli*

SINCE my preliminary note on 'polyporin'[1], further trials of polyporin (filtrate of a *Polyporus* sp. in Czapek-Dox medium-pH 7) have been carried out *in vitro* in plate-cultures (agar-cup method) of typhoid, cholera, dysentery and *B. coli*, 14–25 mm. clear lytic zones have been obtained (see accompanying illustration). A sodium salt of polyporin has been prepared by following with modifications the method of Berger[2]; it is found to have greater potency than the crude filtrate. In broth-cultures of typhoid and *Staphylococcus aureus* the sodium salt produces lytic action in the course of about twenty hours.

Sporophore extracts from dried fruit-body of the *Polyporus* in distilled and saline water produce clear lytic zones in plate-cultures of typhoid, cholera and *Staphylococcus aureus* (Oxford strain); thus they have distinct bacteriolytic action.

The animal experiments with polyporin have shown it to be completely non-toxic. Polyporin is non-hæmolytic; in intramuscular injections it produces no pyrogenic effect in men; it has been found that polyporin retains its potency at room temperature (22°–32° C.) for about a month if maintained in a sterile condition.



THE TYPHOID PLATE, AGAR-CUP METHOD. THE SIZE OF THE CIRCULAR ZONES BEARS RELATIONSHIP TO THE AMOUNT OF POLYPORIN IN THE FOUR CUPS.

In vivo experiments on typhoid and cholera patients in our college hospital are just going on; the results of these with short case-notes will be communicated in due course.

I wish to thank the Indian Health Institute and Laboratory, Ltd., of Beliaghata, Calcutta, for financing this research.

S. R. BOSE.

Carmichael Medical College,
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June 12.

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[1] *Current Sci.*, 13 (Sept. 1944).

[2] *Brit Med. J.*, Jan. 27, 1945.

Microbiological Assay of Riboflavin

MR. E. C. WOOD's plea[1] for a more critical examination of the data of microbiological assays is more than timely. Such an examination not only permits a more accurate interpretation of the results; it can also give an indication of the directions in which the technique most needs improvement.

Because of the presence, in certain types of sample, of substances stimulatory to *L. helveticus*, invalid assays of the type quoted by Mr. Wood are not uncommon. The stimulation is diminished by ether-extraction of the sample[2] and by precipitation of the acid extract at pH 4·5[3], but in our experience it is frequently not entirely eliminated. Although $(a - A)$ may not be statistically significant in a *single experiment*, there is cause for concern in the fact that it is usually positive.

It is now well known that there are many substances that stimulate *L. helveticus* in the presence of sub-optimal concentrations of riboflavin, and it is obviously impracticable—even if it were desirable—to include them all in the basal medium. It is suggested, however, that a medium which gives enhanced responses with sub-optimal doses of riboflavin might be expected to yield more valid assays.

We have confirmed the superiority in this respect of the modified medium proposed by Greene and Black[4]. Higher responses have also been obtained in these Laboratories by increasing the concentration of the factors provided by yeast. Using these 'enriched' media, we have found that there is no longer a direct linear relation between dose and response, but that the curve conforms closely to the normal semi-logarithmic form. Repeatedly we have observed a linear relation between response and log dose over the dosage range 0·04–0·125 γ, and the statistical analysis of the data then follows familiar lines.

Many of the discrepancies between the figures published by different workers for the riboflavin content of the same or similar cereal samples are incompatible with the precision usually claimed for microbiological assays, namely, ± 10 per cent. Andrews[5], for example, reported wide variations between the results of individual collaborators, though a decided improvement was evident in a later survey[6]. Barton-Wright and Booth[7] found higher values for cereals than did Andrews *et al.*[8], and suggested that the latters' extracts were too concentrated.

In our view, pre-treatment of the extracts by some such method as that of Strong and Carpenter is essential for the assay of cereals with the media at present in use. We have observed also that extracts which give positive values for $(a - A)$—and, in consequence, invalid assays—yield considerably lower results on the 'enriched' media referred to above. It is suggested that the lower, rather than the higher, results are likely to be closer estimates of the riboflavin content.

The real solution of these difficulties clearly lies in improving the medium, for attempts to remove stimulatory factors from extracts are, in themselves, admissions of its incompleteness.

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23 Upper Mall,
Hammersmith, London, W.6.

[1] Wood, E. C., *Nature*, 155, 632 (1945).

[2] Bauernfeind, J. C., Sotier, A. L., and Boruff, C. S., *Ind. and Eng. Chem.* (Anal. Ed.), 14, 666 (1942).

[3] Strong, F. M., and Carpenter, L. E., *Ind. and Eng. Chem.* (Anal. Ed.), 14, 909 (1942).

[4] Greene, R. D., and Black, A., *J. Amer. Pharm. Assoc.*, 32, 217 (1943).

[5] Andrews, J. S., *Cereal Chem.*, 20, 613 (1943).

[6] Andrews, J. S., *Cereal Chem.*, 21, 398 (1944).

[7] Barton-Wright, E. C., and Booth, R. G., *Biochem. J.*, 37, 25 (1943).

[8] Andrews, J. S., Boyd, H. M., and Terry, D. E., *Cereal Chem.*, 19, 55 (1942).

Records of *Culex* (*Barraudius*) *modestus* Ficalbi (Diptera, Culicidæ) obtained in the South of England

IN the years 1932 and 1940 respectively, two species of mosquitoes which are widely distributed in the Mediterranean region, namely, *Anopheles algeriensis* and *Theobaldia longiareolata*, were recorded for the first time in Britain: the former from a coastal area in Norfolk[1], and the latter from Portsmouth (Hants)[2]. When recording the first-mentioned immigrants, the late F. W. Edwards suggested that they might have been introduced into Britain by aeroplane, and it seems highly probable that the later invasion admits of a similar explanation; although the alternative that the intruders were sea-borne is admittedly (at any rate where the seaport area of Portsmouth is concerned) a possibility. As, however, no descendants of either of these invaders are known to have survived the ensuing winter, the following British records of yet another Mediterranean species may be found of interest. All the specimens concerned in the present case were collected and identified, by my assistant, J. Staley, in the ordinary course of the mosquit control operations which are carried out under h supervision throughout a coastal area of Hampshi having an area of about forty square miles.

On July 27, 1944, while inspecting coastal ditche on the mainland north of Hayling Island, Mr. Stale caught a female mosquito (after allowing it to bit him) which resembled no known British species. Thi female took a further blood meal, in the laboratory two days later, but died on August 1. On July 29 however, a similar female had been captured in house at Hayling Island, situated about three mile south of the point where the first specimen had bee taken. I will denote the points of capture of th first and second specimen by *A* and *B* respectively The second female refused a blood meal and die shortly afterwards. Reference to literature indicate that the females were of the species *Culex* (*Barraudius* *modestus* Ficalbi.

During the past three years, our control work ha included the monthly inspection of N.F.S. stati water tanks in the city of Portsmouth; and o August 24, 1944, when examining in the laborator some mosquito larvæ collected from one of thes tanks, Mr. Staley found (in company with larvæ o *Anopheles atroparvus* and *Culex pipiens*) three larva of a non-British species which corresponded in every respect with the illustrations accompanying Callot' description of *C. modestus*[3]. On the following day, before the infested water had been oiled by the N.F.S. authorities, three more similar larvæ were collected. From the six larvæ thus obtained, one male and five females were reared. Comparison of the hypopygium of the male with the illustrations given respectively by Martini[4], Barraud[5] and Callot[3] showed that of the last-mentioned writer to be the only entirely correct one.

The tank in which the larvæ were found is situated within two miles of an airport and about five miles to the south-west, and about three and a half miles to the west, of the points *A* and *B* respectively. The fact that the prevailing wind is south-west suggests that the two females captured may have originated from the tank; it is to be noted, however, that the points *A* and *B* are respectively only about two and three miles distant from an aerodrome located eastwards of them.

I reported the above facts to the local authorities concerned, but directed no other attention to the *modestus* immigrants, as I considered it extremely unlikely that any of their progeny would live through an English winter. This assumption, however, has now proved to be incorrect. On May 15 last, in a garden at Hayling Island about half a mile from the point *B*, Mr. Staley was attacked by, and captured, another *C. modestus* female: and on June 15, when examining in the laboratory mosquito larvæ collected in the Borough of Gosport district (into which our control work has recently been extended), he found four more larvæ of the species in question. These larvæ had been collected (in company with larvæ of the salt marsh species, *Aedes detritus*) in a small pool of brackish water situated within a few yards of a river and nearly five miles due west of the tank in which the '1944' larvæ had been found. As this pool had been abolished (by 'filling in') before the collected larvæ had been examined in the laboratory, no attempts to obtain additional specimens could be made. It is to be noted that the Gosport *modestus* larvæ were found in brackish water, whereas the Portsmouth ones of last year were found in a tank containing non-salt water: a fact which accords with Martini's statement that this species breeds both in fresh and partly salt water[4].

The four larvæ were placed in an incubator having an above-water capacity of about 40 cubic inches, and three males and a female eventually developed. One of the males died soon after emergence, and microscopic examination of its genitalia has confirmed he accuracy of Callot's illustrations. The female was given a blood meal on June 30, and laid an egg raft (the eggs of which duly hatched) on July 5. Callot's statement that *C. modestus* is eurygamous is therefore incorrect.

C. modestus is common in many parts of the Mediterranean region, in Asia Minor and in one part of India (Kashmir). Up to now, its most northerly record is from Richelieu, France (about two hundred miles south-west of Paris), where, according to Callot[3], "it attacks men and animals mercilessly". Ficalbi[6] has stated that this species "frequents woods and thickets but also enters houses"; that "it bites during the day, the twilight and the night"; and that "its bite is very painful".

Whether *C. modestus* is further extending its range in Britain remains to be seen. It would obviously be an undesirable addition to the list of British species.

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July 18.

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[1] Edwards, F. W., *J. Ent. Soc. S. Eng.*, **1**, 26 (1932).

[2] Staley, J., *Nature*, **146**, 368 (1940).

[3] Callot, J., *Ann. Parasit.*, **19**, 142 (1942).

[4] Martini, E., "Die Culicidae", 357 (Stuttgart, 1931).

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Granules of the Human Polymorphonuclear Leucocyte

THE oxidase granules of the human polymorphonuclear leucocyte are taken to be protein in nature. Characteristic of the later myeloid cells, these granules are examined in the leukæmic blood disorders in an attempt to define the origin of primitive cells, although the technique for their demonstration is not too easy. This note describes a simple method for the staining of the granules and suggests that they are composed of, or contain, lipines.

Air-dried blood films are fixed for one minute in acetone and air-dried again. Pass the slide through 70 per cent alcohol and leave for ten minutes in a saturated solution of Sudan Black in 70 per cent alcohol. Rinse well in three to six changes of 50 per cent alcohol. Dry in air. Stain with Leishman's or any other of the routine blood stains.

The polymorphonuclear leucocytes show their cytoplasm to be packed with discrete fine granules. These cells are the only ones in the blood smear with the granules, the lymphocyte and monocyte lacking them.

It is noteworthy that the stain used for the demonstration of the granules—Sudan Black—was introduced by Lison[1] as being soluble in all, or nearly all, classes of fats and in fats only. About two per cent of the polymorphonuclear leucocytes contain fat with Sudan IV and this is taken as an indication of aging. The fact that the granules stain with Sudan Black and not with Sudan IV suggests that they are lipine in nature, or contain lipine, and their insolubility in acetone suggests that they are lecithin although by no means proving the point. The fatty nature of the granules seems to be proved finally by their complete solution in ether-alcohol.

Preliminary studies indicate that the Sudan Black granules are present in the cells of the late myeloblast series, as seen in narrow punctures, and that none of the cells obtained in lymph node punctures contain such structures. The granules persist during purulent processes and appear to pass out into the pus. No gross change is noticeable in these granules as a result of fasting or feeding, or in the usual infections encountered in an army general hospital. Studies are being undertaken to investigate the utility of the method in the leukæmias and to demonstrate the Sudan Black material in the leukocyte in various disorders of fat metabolism.

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[1] Lison, L., "Histochimie Animale" (Paris: Gauthier-Villars, 1936).

Origin of Haploid-Diploid Twin Embryos in Angiosperms

IN an interesting article entitled "The present status of Plant Embryology" Dr. Donald A. Johansen[1] makes the following observation (p. 101) regarding the origin of polyembryony: "To cite another instance, if one of the twin seedlings is haploid and the other diploid, it can ordinarily be taken for granted that the diploid seedling arose from a fertilized egg, while the haploid seedling developed either from an unfertilized synergid or from the nucellus or inner integument".

Regarding the first part of the statement, it is necessary to point out that the tissues of the nucellus and inner integument have the sporophytic number of chromosomes and hence any embryo arising from these must be diploid and *not* haploid. Adventive embryos of this kind are of a metromorphic type resembling the maternal parent in chromosome number and other characters.

In respect of twin seedlings, of which one is haploid and the other diploid, it is not easy to be sure if the latter arose from a fertilized egg and the former from a reduced but unfertilized synergid. Kihara (1936; quoted by Cooper[2]), who reported a case of haploid-diploid twins in *Triticum durum*, believes the reverse to be the case, namely, that the haploid member arose from an unfertilized egg and the diploid member from a fertilized synergid. Yamamoto[3] postulated a similar origin for the twins found by him in *Triticum vulgare*. There are also cases on record of antipodal cells giving rise to embryos, which may be diploid or haploid depending on whether any nuclear fusions took place or not prior to the cell undergoing divisions to give rise to the embryo. In *Poa arctica*[4], the origin of the twin embryos, one haploid and the other diploid, has been traced to two different embryo sacs, one originating from a megaspore and therefore having the reduced number of chromosomes and the other originating from a nucellar cell (aposporous) and therefore diploid. The eggs of both the embryo sacs develop parthenogenetically, giving rise to one haploid and one diploid embryo.

Briefly, then, while in any case of twin seedlings, one haploid and the other diploid, it is quite possible and even likely that the former has arisen from an unfertilized synergid and the latter from a zygote, the condition needs careful scrutiny before any judgment can be given. Adventive embryos, however, whether originating from the nucellus or the integument, are diploid.

P. Maheshwari.

Dacca University,
Dacca.
April 21.

[1] Johansen, D. A., *Bot. Rev.*, **2**, 87 (1945).

[2] Cooper, D. C., *Amer. J. Bot.*, **30**, 408 (1943).

[3] Yamamoto, Y., *Bot. Mag.* Tokyo, **50**, 573 (1936).

[4] Engelbert, V., *Canadian J. Res.*, C, **19**, 135 (1941).

Origin of Toxicity to Fungi in Wareham Heath Soil

Dr. Brian's discovery of marked antibiotic activity by species of *Penicillium* present in Wareham soil is a welcome addition to our knowledge of the factors directly responsible for the observed inhibition of microbiological activity in this soil, with the resulting pronounced biological inertia and infertility for plant growth[1].

The presence of a factor or factors of biological origin actively toxic or antagonistic to fungus growth and normal root development was suggested by me in a paper published in 1934[2]. The correctness of this hypothesis was later fully established[3]. It would have been indeed a fortunate coincidence if the discovery of penicillin and realization of the important part played in Nature by the production of bacteriostatic and fungistatic substances had come in time to direct attention at that stage of the work to the species of *Penicillium* observed in samples of Wareham soil, more especially in those selected as likely to exhibit the highest degree of toxicity.

Incidentally, our observations suggested that the distribution and abundance of the soil *Penicillium* spp. present is sporadic throughout the experimental area and possibly influenced by seasonal conditions. Until further data are available, it must remain an open question whether gliotoxin as such is the immediate cause of all the observed phenomena in Wareham soil, including especially limitation of growth of those mycorrhizal fungi known to be present involving either complete failure of mycorrhizal activity, or the development of mycorrhizas structurally and functionally abnormal; or whether this substance is one—perhaps the chief initiating cause—of a number of disturbances of microbiological origin leading ultimately to soil infertility. The differential susceptibility of air-borne micro-organisms present on plates tested by the agar-film method had been noted and the resistance of *Penicillium* spp. as compared with *Mucor* spp. and other air-borne infections is possibly of some significance.

Dr. Brian's observations on the mycorrhizal and other fungi sent to him are of particular interest. Of these fungi, *Boletus bovinus*, *B. elegans*, *Mycelium radicis nigrostrigosum* and *Phoma radicis callunæ* are mycorrhiza-formers. *B. bovinus* was the only known mycorrhiza-former of pine and spruce initially present throughout the area. *B. elegans* does not occur on the area but appears in adjoining woods of larch, of which it is a proved mycorrhiza-former; nor has *Mycelium radicis nigrostrigosum* ever been observe unless introduced in soil inocula, although this fung is extremely abundant as a mycorrhiza-former i woods of Scots pine adjoining the area. *Phom radicis callunæ* is the mycorrhiza-former of *Callun vulgaris*, a natural dominant on Wareham heath.

The differential susceptibility of these mycorrhiz fungi to gliotoxin, as recorded by Dr. Brian, is i agreement with all observations and facts relatin to growth activity in the case of those present o the experimental area, and, in the case of those n present, for example, *B. elegans* and *M. radic nigrostrigosum*, accords with expectation.

The case of *Phoma* is of special interest. Th endophyte shows relatively slight susceptibility, a might be expected from its wide distribution throughout the area in mycorrhizas of *Calluna*. That som susceptibility exists is in agreement with observations made by me at an early stage of the Wareha researches in respect of relatively slight and varying degrees of abnormality in mycorrhizal developmen and structure observed in mycorrhizas of *Callun vulgaris* on the heath-land before ploughing.

The reaction of the pseudomycorrhiza-former *Mycelium radicis atrovirens* and *Rhizoctonia* sp. is als of interest. *M. radicis atrovirens* is present throughout the area, but is relatively rare and has not been observed to attack either pines or spruces in the field. *Rhizoctonia silvestris*, the form sent to Dr. Brian, does not occur in Wareham soil. In respect of *M. radicis atrovirens*, it would be of particular interest to have a comparative test of a form imported in a Swedish soil that proved to be highly pathogenic to Norway spruce under Wareham conditions[4].

The title given to Dr. Brian's communication is unfortunate. The use of 'mycorrhiza' in the singular to describe the general phenomenon is now recognized as incorrect and has been given up by those familiar with the facts. The toxicity recorded by Dr. Brian is to 'mycorrhizal fungi' and not to 'mycorrhiza'.

M. C. Rayner.

Bedford College,
University of London.
June 16.

[1] Brian, P. W., Hemming, H. G., and McGowan, J. C., *Nature*, **155**, 637 (1945).

[2] Rayner, M. C., *Forestry*, **8**, 96 (1934).

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[4] Rayner, M. C., *Forestry*, **15**, 1 (1941).

Nutritive Value of Coco-nut

The communications on the nutritive value of coco-nut by Dr. Lucius Nicholls and Sir Jack Drummond[1] were read by us with interest.

In 1941, while working with the microbiological assay of vitamins, stories of seamen and aviators stranded on 'coco-nut isles' became common, and it occurred to us to measure the vitamin content of the 'coco-nut milk' popularly supposed to be the dietary mainstay under such conditions. The values listed are those obtained for the centre fluid of an apparently normal specimen obtained at a local grocery store.

Nicotinic acid	0 04	micrograms/c c.
Pantothenic acid	0 52	,,
Biotin	0 02	,,
Riboflavin	< 0 01	,,
'Folic acid'	0 003	,,

The concentration of two other vitamins for which microbiological assays were not available, thiamin and pyridoxine, were so low as to be negative toward olour tests, even though the material was first conentrated to some extent by adsorption and elution.

It is evident that the juice was not of high nutritive quality. The minimum daily requirement of riboflavin, for example, according to the Food and Nutrition Board of the U.S. National Research Council, for a 'very active' individual of 70 kilos is 3·3 mgm. per day. To meet this requirement, the daily consumption of coco-nut juice would have to be at least 330 litres.

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Nature, **155**, 392 (1945).

Spectral Analysis of Solid Substances

A METHOD has been developed whereby it is possible to deduce from a single spectral photograph not only the qualitative analysis of a totally unknown mineral powder, but also its *approximate* quantitative composition.

For this purpose mixtures have been made of all spectrographically detectable elements at our disposal; the concentrations were 10, 3, 1, 0·3, 0·1 down to 0·0001 per cent. Pure, washed quartz-sand was used as a basis for the various dilutions.

In order to reduce the amount of work and time required for the preparation of the standard spectrograms, the elements which had to be considered were divided into groups of ten, the sensitive lines of which do not coincide. Quantities of the pure chemical compounds, equivalent to 100 mgm. of the oxides, of all elements of the same group were thoroughly mixed in an agate mortar under alcohol. One tenth of this mixture was added to 900 mgm. of the pure quartz powder, thus obtaining a mixture containing 1 per cent of each of the oxides concerned.

The lower concentration steps have been obtained by diluting this 1 per cent mixture with a calculated amount of pure silica. The higher concentration steps have been prepared as follows: (*a*) for the 10 per cent mixture: 100 mgm. of the oxide of each element were mixed with 900 mgm. of pure silica; (*b*) for the 3 per cent mixture: 300 mgm. of the 10 per cent mixtures of each member of a subgroup of three elements of the same group were ground with 100 mgm. of the pure quartz sand.

Before taking the spectrogram, each mixture was mixed again with half its weight of sodium carbonate.

The photographs were taken with the continuously burning electric arc between very pure, plane carbon electrodes of 5 mm. diameter. The arc burns for 60 sec. at 4 amp., and then for 30 sec. at 7 amp. We used a Hilger E.315 quartz spectrograph. A diffusely and uniformly illuminated slit is obtained by focusing the arc sharply on a screen in which is inserted a rectangular diaphragm; the illuminated opening of this screen is focused enlarged on the collimator lens of the spectrograph.

A rotating step sector (factor $r = 3{\cdot}5$) was placed before the slit of the spectrograph. The intensity of the lines chosen for analysis is compared for each concentration with the intensity of certain Si-lines from the spectrum (the concentration of silica being approximately constant). This comparison is performed visually, under a twenty-fold enlargement, with a Zeiss spectral projector. The relative intensity (rather the relative exposure) is denoted by the difference in the number of 'steps' to be applied to the two lines under comparison in order that they may show equal blackening[1].

For the lowest concentrations a spectrum is taken with illumination forming an image of the arc on the slit, without a step sector, the cathode layer effect being used. Again the intensities of the weak lines are compared with those of the Si-lines of the stepped spectrum.

Tables have been drawn up, giving the relative intensities as a function of concentration, for the most prominent lines of fifty-six different elements.

A number of synthetic mixtures have been prepared, and then analysed by means of the method described, with the aid of the data of our tables. Some results are given in the accompanying table, which includes also the results for a natural mineral (tourmaline).

It will be seen that a fair estimate of the concentration of the elements present is obtained.

I			II			III (tourmaline)		
	Calculated	Found		Calculated	Found		Chemical analysis	Spectral analysis
CaO	5	3–4	CaO	0·16	0·12	CaO	1·35	1·30
MgO	0·1	0·15	MgO	0·8	0·7	K_2O	2·07	2–3
MnO	0·41	0·40	MnO	0·2	0·35	Na_2O	2·25	
Fe_2O_3	0·2	0·3	Fe_2O_3	1·0	1·0	Fe_2O_3	12·35	14·2
Al_2O_3	0·04	<0·4	Al_2O_3	2·5	1·7	Al_2O_3	24·67	30·0
TiO_2	0·1	0·14	TiO_2	0·04	0·05	MgO	7·32	6·3
ZrO_2	0·04	<0·1	B_2O_3	0·8	0·5	MnO	0·27	0·25
V_2O_5	0·012	0·02	K_2O	0·4	0·3	TiO_2	0·34	0·39
Cr_2O_3	0·012	0·01				B_2O_3	6·89	5·5
						CuO	<0·05	0·03
						(SiO_2	37·5	18·6)

The complete account of this work has been communicated to the Koninklijke Vlaamsche Academie v. Wetenschappen, Letteren en Schoone Kunsten v. Belgie, and will be published in the *Verhandelingen* from this Society.

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May 3.

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[1] See Breckpot, R., *Spectrochim. Acta*, **1**, 2 (1939).

A Tetrabromide of β-Phellandrene

IT has been generally accepted that β-phellandrene does not form a tetrabromide, and indeed we have found no reference in the literature to the formation of such a compound by a conjugated terpene apart from a recent record of a liquid tetrabromide derived from α-terpinene[1]. During examination of the terpene fractions of the oil from *Eucalyptus cneorifolia*, we repeatedly isolated a crystalline tetrabromide which had m.p. 110–112° and was *dextro*-rotatory. After recrystallization from ethyl acetate, the melting point rose to 118–119°, the specific rotation being almost + 54°.

Microanalysis established the formula of the substance as $C_{10}H_{16}Br_4$, and the hydrocarbon recovered on treatment with magnesium and ether[2] showed the characteristic features of *l*-β-phellandrene, forming, for example, a nitrosite[3] and a nitrosochloride[4]. That the tetrabromide was derived from this hydrocarbon was supported by the formation of a crystalline derivative from a sample of *l*-β-phellandrene isolated from Canada balsam oil. This had practically identical physical properties, and on admixture with the sample from the eucalyptus oil there was no depression of melting point.

The chief feature of the tetrabromide from β-phellandrene is the change of sign of rotation, the *lævo*-rotatory hydrocarbon giving a *dextro*-rotatory tetrabromide. The investigation was further extended by formation of a crystalline tetrabromide from a sample of *d*-β-phellandrene derived from water fennel oil (*Phellandrium aquaticum* L.)[5]. This also had a melting point of 118–119° and had a specific rotation of − 53°.

A detailed account of the work will be published elsewhere.

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A. KILLEN MACBETH.

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April 10.

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[1] Ipatieff and Pines, *J. Amer. Chem. Soc.*, 66, 1120 (1944).
[2] von Braun and Lemke, *Berichte*, 56, 1562 (1933).
[3] Macbeth, Smith and West, *J. Chem. Soc.*, 119 (1938).
[4] West, *J. Soc. Chem. Ind.*, 58, 122 (1939).
[5] Berry, Macbeth and Swanson, *J. Chem. Soc.*, 1448 (1937).

Symbols Used to Indicate Hydrogen Ion Concentration and Similar Quantities

THE symbols pH and pK, commonly encountered in chemical literature, each consist of two letters, the second of which may, or may not, be used as a subscript, and either or both of which may be set alternatively in roman type or in italics. There appears to be no generally accepted convention governing the choice from the many resulting possible forms, and inconsistencies are often encountered even within a single published article.

According to its origin, the letter 'p' in the symbol pH is an operator describing a function of the variable denoted by the letter 'H'. Presumably in order to show the different significances of the two letters in the compound symbol, it was originally written with a subscript 'H' by Sörensen. This arrangement, besides being somewhat inconvenient, seems to give undue prominence to the operator. In the more recent and common form $p\mathrm{H}$, the difference in type sufficiently marks the different duties of the two letters, but is opposite in direction to that conventionally used in other functional symbols, such as log T or dt. From this point of view, $\mathrm{p}H$ appears a more consistent form. There is, however, much to be said in favour of dropping the distinction in type between the two letters, and of regarding the quantity denoted by pH as an important independent variable without reference to its derived origin. Although the compound symbol may have a unique meaning, this is not necessarily true for its component letters; thus, H may denote a concentration and p a negative logarithm, or—sometimes more conveniently —H a dilution and p its logarithm. It is suggested that, in agreement with the accepted convention for single-letter symbols, all compound symbols in which p is used as an operator should be set in uniformly italicized type, as pH, pK, etc., without speci advertisement of their derivations.

In chemical texts, the symbol pH (or its ty variants) is commonly used as a noun, as in t phrase "The determination of pH", though for th purpose it is sometimes expanded to 'pH value There is little to be said in favour of 'pH value which is longer, and no more descriptive, than p If the demand for brevity constrains us in the futu to replace the noun 'time' by the symbol t, the inco sistency of 't value' will quickly become obviou Much the most common plural form of the noun 'pH values' (or its type variants), a fact that prob ably reflects our uncertainty as to the correct plural of the letters of the alphabet, and our resolve t mind our grammatical P values and Q values. Th correct plurals of $p\mathrm{H}$, $\mathrm{p}H$, pH and pH are respectivel pH's, pHs, pH's and pHs. The rule is simpl If there can be any doubt whether the final 's' is plural ending or a part of the symbol proper, a apostrophe is required; but if a difference in typ between the final letter of the symbol proper an the plural 's' avoids this ambiguity, no apostroph should be used.

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Unshrinkable Wool

ONE of the more recent processes for making woo unshrinkable consists in synthesizing an organi polymer on the surface of the fibres[1], thus masking the surface-scale structure which is the primary cause of shrinkage. Precisely similar results may be obtained with inorganic polymers.

For example, when flannel is immersed in a solution of silicon tetrachloride in carbon tetrachloride, a vigorous reaction takes place between the adsorbed water of the wool and the silicon tetrachloride, a siliceous deposit being formed on the surface of the fibres. In consequence, the treated fabric shrinks very much less than untreated fabric during milling, as may be seen from the following data. These were obtained by treating 2·5 gm. patterns of flannel, previously conditioned at 65 per cent relative humidity and 22·2° C., with 100 c.c. of a solution of silicon tetrachloride in carbon tetrachloride for five minutes at 25° C. After treatment, each pattern was washed in two changes of 100 c.c. of carbon tetrachloride, followed by running water overnight, and the series of patterns was then milled by hand in 5 per cent soap solution.

Concentration of silicon tetrachloride (per cent by volume)	Percentage shrinkage in area during milling
0	28 9
2	18 9
5	6·2
7	3 6
10	2·6

A high degree of unshrinkability is readily obtained, and it is clear that polymerizable inorganic compounds are likely to find important practical applications in the wool textile industry.

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J. B. SPEAKMAN.

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May 26.

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[1] Baldwin, Barr and Speakman, *B.P.* 567,501.

A New Test for 2 × 2 Tables

If an experiment yields results in the form of a × 2 table:

	P	not-P	Total
A	a	c	m
B	b	d	n
Total	r	s	N

here m and n have been fixed in advance, a test r deciding whether there is evidence of association etween the attributes A and B and the mutually xclusive and exhaustive attributes P and not-P has een given by Fisher[1]. This test, on the null hypoesis of no association, associates the results with probability $m!n!r!s!/N!a!b!c!d!$.

It has been usual in the past to apply this test, or me approximation to it[2,3], in cases where we can sume that the probability p_1 that A has P and the robability p_2 that B has P are both constant. The ypothesis tested then becomes $H(p) \equiv p_1 = p_2 = p$.

It is, however, possible to construct a more powerl test of the hypothesis $H(p)$ on the data given. he table above can be represented geometrically by e point (a,b) in a plane lattice diagram of points ith integer co-ordinates. Since m and n are fixed advance, all possible results will then be represented y points of the lattice lying in a rectangle bounded y the x and y axes and the lines $x = m$ and $y = n$. he hypothesis $H(p)$ assigns a 'weight'

$$W(a,b,p) = (m!n!/a!b!c!d!)p^r(1-p)^s$$

the point (a,b). To obtain a valid test of $H(p)$ on gnificance level α, we have only to choose a region R the rectangle such that

$$\underset{0 \leqslant p \leqslant 1}{\text{Max}} \sum_R W(a,b,p) \leqslant \alpha.$$

This validity condition does not determine R niquely. To obtain a reasonable test, we must reuire that R should consist of as many points as ossible, and should lie away from that diagonal of he rectangle which passes through the origin. ormulated mathematically, these latter requireents mean that the complement of R must in a ertain sense be convex, symmetrical and minimal.

For example, when $m = n = 3$, and $\alpha = 1/32$, R onsists of the two points (3,0), (0,3). The correspondng level of significance with Fisher's test is 1/10. hus the new test is more powerful than Fisher's.

The computation involved in making tables for the ew test is heavier than with Fisher's test. But once repared, the tables for the new test are on the whole nore convenient in use.

The relationship between Fisher's test and the new est is similar to that between Pitman's 'exact' test or identity of two distributions and the correspondng t-test. For large values of a, b, c and d, the differnce between the two tests becomes small. For large n,n and small a,b, there is an analogue of the new rocedure, just as there is an analogue of Fisher's[4].

This work has been carried out as part of the rogramme of the Ministry of Supply. Full details, ith tables, will be published elsewhere.

G. A. Barnard.

Ministry of Supply, Berkeley Court,
Glentworth Street, London, N.W.1.
May 11.

Fisher, R. A., "Statistical Methods for Research Workers" (Edinburgh: Oliver and Boyd, 1941), 94.

Fisher, *loc. cit.*, 88.

Yates, F., *J. Roy. Stat. Soc.*, Supp. 1, 217 (1934).

Przyborowski, J. and Wilenski, H., *Biometrika*, 31, 313 (1940).

Crystal Structure of Barium Titanate

Recently Rooksby[1] and Megaw[2] have reported a tetragonal structure for barium titanate. This is of interest to us because we also have obtained X-ray powder photographs of barium titanate, from which we have established a tetragonal structure. In addition we have obtained photographs of a lattice which at first was regarded as near cubic, though in view of our subsequent findings, it appears more correct to regard it as being near tetragonal. However, the reversible temperature change of structure from tetragonal to cubic reported by Miss Megaw[2] raises the question as to whether this cubic structure might not exist at ordinary temperatures, as a result of heat treatment, or method of preparation, or presence of impurities.

The energy difference between the structures may not be large, but the change from tetragonal to cubic would appear to involve a rearrangement of the ions if the cubic structure is to be regarded as of the ideal $G5$ type, as hitherto assumed[3]. The change in structure may be connected with a very slight change in the Ti—O bond-length.

W. F. Forrester.
R. M. Hinde.

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British Insulated Cables, Ltd.,
Prescot, Lancs. May 16.

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[1] Rooksby, H. P., *Nature*, 155, 484 (1945).

[2] Megaw, Helen D., *Nature*, 155, 484 (1945).

[3] Naray-Szabo, I., *Naturwiss.*, 31, 202 (1943).

Particle Shape

The recent letters in *Nature* by Messrs. Whittaker and Tomkeieff[1] make no mention of the extensive investigations of particle shape carried out in connexion with road aggregates. A bibliography of the subject is given in my first paper[2].

In my work at the Road Research Laboratory[2,3], shape was defined in terms of the principal dimensions of the particle, which correspond roughly to its length, breadth and thickness. The ratios of length to breadth and thickness to breadth are taken as a measure of the degree of elongation and flakiness of the particle. By selecting arbitrary limits, it is possible to determine the amount of 'elongated' and 'flaky' particles and to express these in percentage by weight as indexes of shape. This assumes a more or less regular distribution of particle shapes in such materials, which has been found to be the case in practice[2,3]. This is the basis of the method adopted in British Standard 812: 1943, "Sampling and Testing of Mineral Aggregates Sands and Fillers" (Method 2).

This method, of course, only gives a partial definition of particle shape. An obvious omission is the degree of roundness of the particles, which is independent of the 'shape' as defined above. Another shape characteristic is the angularity of crushed particles. Particles classified on length and thickness can be further classified according to these characteristics. The shape characteristics of interest to any industry must be determined to suit the particular case.

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[1] *Nature*, 155, 331 and 639 (1945).

[2] Markwick, A. H. D., *Chem. and Ind.* (London), 56 (9), 206 (1937).

[3] Markwick, A. H. D, Road Research Bulletin No. 2 (H.M. Stationery Office, 1937).

RESEARCH ITEMS

Previously Spawned Salmon in Irish Rivers

ARTHUR E. J. WENT has discussed the question of the proportion of previously spawned fish in different Irish rivers (*Sci. Proc. Roy. Dublin Soc.*, **24** (N.S.), No. 1, March, 1945). The results are given of the examination of scales from fish taken from nineteen rivers; 25,029 scales were examined, of which 1,078 or 4·3 per cent were from previously spawned fish. Only 1·1 per cent of these had spawned previously on two occasions. None had spawned three or more times. It is found that where there is a large commercial fishery in the tidal waters, there is a tendency for the proportion of previous spawners to be low, but when there are one or more lakes on the river the proportion appears to be high, with few exceptions. Comparing the results with earlier investigations, it is shown that the estimated proportion of previous spawners for the country as a whole is 4·3 per cent. Kelts have little food value, but after recovery may be almost double their original weight—a good reason for protecting them.

Effect of Sulphanilamide on the Sugar Consumption of *Bact. coli*

FURTHER examination of the influence of sulphanilamide compounds on *Bact. coli* (*Prak. Acad. Athens*, **15**, 472; 1940) has been recorded by N. Klissiūnis (meeting of Feb. 10, 1944, of the Academy of Athens). Sets of flasks containing 0·4 gm. sugar and 12 c.c. of a 4 per cent peptone-sodium chloride solution were prepared, to some of which sulphanilamide 'prontalbin' was added. After sterilization at 110°, the medium was inoculated with a suspension of *B. coli* and incubated at 37° and at 41°. Four days later, the cultures were boiled, and after precipitation of the albumin by a solution of lead subacetate and subsequent neutralization of the excess lead with sodium sulphate, the flasks were filled up and the contents filtered. A portion of this filtrate was examined for sugar by Bertrand's method. It was found that more sugar had been decomposed in the flask not containing sulphanilamide. The *p*H in presence of sulphanilamide was also slightly changed, while in the controls the *p*H increases to 4·4. The bacteriological examination shows that at 41°, in presence of sulphanilamide, the *B. Coli* were killed more quickly than at 37°.

Blind Seed Disease of Rye-grass

A DETAILED account of the blind seed fungus of rye-grass crops has recently been published by Malcolm Wilson, Mary Noble and Elizabeth G. Gray (*Trans. Roy. Soc. Edin.*, **61**, Pt. 2, No. 12, 327; 1945). The fungus was originally named *Phialea mucosa* but the present authors agree that it is possibly identical with *P. temulenta*. Infected seed shows no external disfigurement, but removal of the glumes reveals caryopses, rusty brown in colour, with masses of macroconidia. No seedling emerges when the seed is sown; it apparently remains undeveloped until May of the following year, when apothecia are produced by the fungus. Ascospores from these fructifications enter between the glumes of the flowering rye-grass and attack the developing seed. The disease was serious in 1938 and 1939, but does not seem to have given a great amount of trouble since. Strains of the fungus producing mycelium only, or mycelium and macroconidia, were found, though both types bore microconidia. The paper discus possible relationships of the causal organism wi endophytic fungi of the rye-grass and related speci and its possible toxicity to farm animals is also co sidered. Several methods of control have been trie though not with much success as yet—the paras is protected against dry seed disinfectants by t glumes.

Phosphorus Deficiency of Fruit Trees

Both in Great Britain and in America phosphor deficiency of fruit trees in the field is of rare occ rence, but L. R. Bryant and R. Gardner (*Proc. Am Soc. Hort. Sci.*, **42**, 101; 1943) describe sympto exhibited by pears grown in a soil in which su flowers responded exceptionally well to phospha dressings. The leaves of the pear were smaller th normal and showed a severe marginal and apic burning early in the season. Fruit failed to devel and there was a die-back of new shoots. Pot cultu indicated that the development of these sympto could be prevented by the addition of superphospha to the soil. Sulphur (10 lb. per tree) too was benefici but potash dressings were without effect.

Use of Carbon Dioxide in Fruit Storage and Transport

A NUMBER of papers (*Proc. Amer. Soc. Hort. Sc* indicate some of the ways in which carbon dioxi may be employed to reduce losses during transpo and short-period storage of fruits. F. Gerhard E. Smith and H. English (**38**, 243; 1941) find th in an atmosphere containing carbon dioxide ripeni of apricots is retarded. The effect is almost as gre with five per cent as with twenty per cent carbo dioxide; but if the period required for ripening e ceeds ten days, mealiness, a pale colour and insip flavour and discoloration near the stone may resul but the ill-effects of the carbon dioxide are muc less noticeable at low (30° F.) than at higher (45° F temperatures. Peaches are more tolerant of carbo dioxide and do not deteriorate if the carbon dioxi concentration reaches twenty per cent. Fifteen p cent of carbon dioxide in the atmosphere will mai tain strawberries in good condition for three to fo days at 50° F., the colour being retained better a this temperature than at 32° F. (A. V. Doreen, M. H Hoffman and R. M. Smock, **38**, 231; 1941). Swee cherries may be kept for three weeks at 40° F. i air containing twenty per cent of carbon dioxide and with this concentration of carbon dioxide, brow rot and other decays of the fruit are checked. Te per cent of carbon dioxide and a temperature o 42° F. retard the ripening of plums as effectivel at a temperature of 32° F. in ordinary air (F. W Allen, W. T. Pentzer and C. O. Bratley, **44** 141; 1944). The use of carbon dioxide permit the storage of plums at a higher temperature tha would otherwise be possible, and this is importan as with some varieties breakdown occurs unless th storage temperature is above 40° F. (W. T. Pentze and F. W. Allen, **44**, 148; 1944).

Post-Jurassic Intrusions of the Aldan Region, Eastern Siberi

A VALUABLE contribution by Y. A. Bilibin to the petrogenesis of alkaline igneous rocks has been pub lished in *Petrography of U.S.S.R.*, Ser. 1, *Regiona Petrography* No. 10; *Inst. Geol. Sci., U.S.S.R. Acad Sci.*, 1941 (in Russian). The Aldan Plateau, betwee the Lena River and the Stanovoi Mountains, consist of a Pre-Cambrian complex with flat overlyin ambrian limestones and Jurassic shales. Later trusive rocks show the following sequence:

1. Concordant masses of porphyry with or without quartz, gether with melanocratic varieties.
2. Laccoliths, stocks and dykes of a wide range of alkali rocks, cluding pseudoleucite-syenite, -porphyry, -tinguaite and -leucitite, d shonkinite, foyaite, pulaskite, solvsbergite and bostonite.
3. Laccoliths, stocks and rare dykes of fine-grained calc-alkali cks, including monzonite, augite-syenite and melanocratic syenite.
4. Stocks and dykes of aegirine-granite, grano-syenite and corre-onding porphyries.

he author discusses the various hypotheses that ave been suggested to account for the origin of lkali rocks. Desilication by limestone assimilation rejected for this region on the grounds that (*a*) lkali rocks occur not only in the Cambrian lime-tones but also in the Pre-Cambrian complex, even t levels 300–400 m. below the base of the limestone; nd (*b*) contact action against the limestone is emonstrably negligible, except by the augite-yenites, where the reaction products are basic ioritic rocks. Concentration of alkalis by volatiles is ismissed, since there is no mineralogical evidence f the former presence of any unusual abundance of olatiles. It is inferred that the rocks were not pro-luced by magmatic differentiation at the levels now xposed. The author suggests the possibility that issociation of, for example, the leucite molecule takes lace at depth. By differential diffusion of the liber-ted constituents, the peripheral zone of the magma eservoir becomes enriched in K_2O; the intermediate one in K_2O and SiO_2; and the central part in Al_2O_3.

Atomic Weight of Beryllium

THE accepted international atomic weight of beryllium is 9·02. This is almost 0·1 per cent smaller than the value given by the most recent determination by the mass spectrograph—9·0126—reported by Flügge and Mattauch (*Ber.*, **76**, 1; 1943). Johannsen (*Naturwiss.*, **31**, 592; 1943) has therefore undertaken a revision of the atomic weight of beryllium by chemical methods, using the ratios $BeCl_2 : 2Ag$ and $BeCl_2 : 2AgCl$. This method was used in 1922 by Hönigschmid and Birckenbach (*Ber.*, **55**, 4) who obtained 9·018 for the atomic weight. In the present work, pure beryllium chloride was made by the action of chlorine on beryllium oxide and sugar charcoal at a red heat. The substance was then sublimed, first in an atmosphere of chlorine, then in nitrogen, and finally in a high vacuum, without the substance melting, thus avoiding any action on the containing vessel. The sublimed chloride was a snow-white, micro-crystalline mass. The substance was weighed in evacuated sealed tubes, which were then broken under water. The chlorine in the solution was determined against silver by the nephelometric method. Eleven determinations of the ratio $BeCl_2 : 2Ag$ gave values lying between 9·012 and 9·015, the mean value being 9·013 ± 0·0007. Ten determinations of the ratio $BeCl_2 : 2AgCl$ gave values lying between 9·011 and 9·015, with a mean of 9·013 ± 0·0012. The most probable value of the atomic weight of beryllium is thus 9·013, agreeing well with the mass-spectrographic value.

Separation of Casein

ALTHOUGH there was evidence that casein is not a pure homogeneous protein, it was not until Linderstrøm-Lang and Kodama, in 1925, published solubility studies that casein was definitely known to be a mixture. In 1939, Mellanby reported an electrophoretic study, finding three peaks, which he designated α, β and γ casein. R. C. Warner (*J. Amer. Chem. Soc.*, **66**, 1725; 1944), by an application of the Tiselius electrophoretic method, correlated with methods of chemical fractionation designed to be as mild as possible, finds a separation into two fractions, α- and β-casein, which represent the two peaks in the electrophoretic pattern of casein at *p*H 7. The fractions were not electrophoretically homogeneous under all conditions, but they were purified so that neither fraction contained any of the other. The possibility of the existence of complex formation between α- and β-casein is discussed.

Long Transmission-line Problems

IN a recently published paper (*J. Inst. Elec. Eng.*, **92**, Pt. 2, No. 25, Feb. 1945), R. H. Paul presents two rigorous methods of solving transmission-line problems which avoid the use of charts or tables of hyperbolic functions of complex angles. In the first of these, the voltage and current at any point are shown to be due to two waves, one travelling forward, the other backward, attenuating as they travel, the vectors of the two waves being calculated from receiving end conditions. From these the wave vectors at any other point are derived and the latter, when compounded, lead to the voltage and current at that point. In the second method the complex angle of the load is determined from the forward and backward wave vectors and to this is added the complex angle of the line. The voltage and current are proportional to the hyperbolic cosine and sine respectively of the total angle. The magnitudes of these can be calculated, using circular and hyperbolic functions of real angles. A semi-graphical method of finding the current and voltage at several points on the line is then developed.

Southern Comparison Stars for Eros

R. H. Stoy and A. Menzies, in "Re-Observation of the Magnitudes of the Southern Comparison Stars for Eros" (*Mon. Not. Roy. Astro. Soc.*, **104**, 298; 1944), have produced a sequel to an earlier paper in which an attempt was made to link the Cape magnitude system with the international system. The earlier paper was based on the observation of certain members of the Hyades, Præsepe and Pleiades clusters; but owing to the absence for these stars of well-determined magnitudes on the international scale, the attempt was not altogether a success. For this reason re-observations of some of the southern comparison stars of Eros have been conducted at the Royal Observatory, Cape of Good Hope, and comparisons of these with other results are interesting. Table 2 gives the magnitudes, on the Cape system, of 247 of the stars which were used as comparisons for Eros during its 1931 opposition, and of 86 brighter stars in the same region of the sky. On comparing these magnitudes with those determined at Yerkes and Mount Wilson, it is seen that the Yerkes magnitudes require a large systematic correction, depending on the declination, for both photographic and photovisual magnitudes. The lower the stars are in the sky at Yerkes, the brighter they appear, and it seems probable that something of this systematic effect has been carried over into the Mount Wilson magnitudes. Some of the causes for this effect are discussed, and in view of the large systematic errors that affect both the Mount Wilson and Yerkes magnitudes of the Eros comparison stars, neither series can be regarded as an accurate representation of the international scale as embodied in the North Polar sequence.

SWEDISH OCEANOGRAPHY DURING THE WAR

By PROF. HANS PETTERSSON
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ON January 24, 1939, the Oceanografiska Institutet in Göteborg, given to the Royal Society of Göteborg by the Wallenberg Foundation, was inaugurated[1]. Since then it has worked in close co-operation with the Svenska Hydrografisk-Biologiska Kommissionen, which has in this way received a valuable addition to its own research facilities, Bornö Station and Havsfiskelaboratoriet, both situated at the Gullmar Fjord, and the research ship *Skagerak*. At the beginning of August 1939 the *Skagerak* was engaged on an international cruise in the Baltic. One month later the ship was commandeered by the Swedish Navy and has since then been serving as an auxiliary gun-boat.

Cut off in this manner from active work at sea, Swedish oceanographers have had to fall back on work in the laboratory and within territorial waters on board chartered vessels. Occasionally, thanks to the courtesy of the naval command and of the Hydrographic Office in Stockholm, short cruises for special purposes have been carried out with the *Skagerak* and with the survey ships *Gustaf af Klint* and *Svensksund*. Some results gained in the course of five years work are summarized here.

Current measurements in the Baltic made with O. Pettersson's recording current meter suspended from submerged carrier buoys had in 1931 led to the discovery of rotating 'inertia-currents' with a period of twelve pendulum hours. During the cruise in the summer of 1939 four ships were co-operating according to a programme proposed by Sweden at the last meeting of the International Council before the War. Observations made simultaneously from these anchored ships led to important results, published by Dr. B. Kullenberg of this Institute in co-operation with Dr. I. Hela of the Havsforskningsinstitutet in Helsingfors[2]. Except close to the coast-line, rotating currents were found at all stations. At fifteen metres depth they had an amplitude of nearly 20 cm./sec. and, within the margin of experimental errors, the same phase. At two of the stations tidal currents of the M_2-period with an amplitude of 1–2 cm./sec. were discovered, the first record of tidal currents in the Baltic.

In the 'plankton-shaft' of the new Institute, which is twelve metres deep and two metres in diameter, large-scale plankton cultures under controlled conditions have been made with diatoms from the spring increase, a good crop of *Skeletonema costatum et al.* being obtained[3]. Afterwards a brood of copepods was kept alive for several weeks in the shaft. Unfortunately, Dr. Fabius Gross, who in the spring of 1939 arrived from Edinburgh to carry out these experiments together with Dr. F. Koczy, of this Institute, has been prevented by the War from co-operating in the continued work. Attempts at 'manuring' the water of a small Swedish fjord, undertaken originally by the author some years before, have recently been resumed here in an enclosed bight particularly suited for the purpose. Excellent results from similar experiments made in Scotch lochs have in the meantime been reported by Dr. Gross and co-workers[4].

Research on the vitamin content in marine phytoplankton by the author has been continued in co-operation with the State Institute of Publ Health in Stockholm, where the biological analyse for vitamin D have been made. From large catche of diatoms collected during the spring increase weighing up to 80 kgm. in a wet condition, the fat soluble substances have been extracted and tested for antirachitic vitamins with and without previous irradiation by ultra-violet light. Whereas experiment with non-irradiated plankton and extracts gave indefinite results, the extracted oil, after exposure to ultra-violet light, gave variable but fairly large yield of vitamin D; in one case a maximum of 2,800 I.U. per gram of the oil was found. This implies tha there are fair amounts of the provitamin, probably 7-dehydrocholesterol, present in the diatoms. Separate tests with chickens are now being made in orde to ascertain whether the active substance is vitamin D_2 or not. The conversion of the provitamin into the vitamin by submarine daylight must remain a subjec for further research.

The last-named results give an enhanced interest to the short-wave components of submarine daylight and their possible importance for the ecology of the sea Dr. N. G. Johnsson at Bornö Station has at the author's request carried out measurements on the intensity of the antirachitic rays in the waters of the Gullmar Fjord, using rectifying selenium cells deprived of their lacquer coating and exposed behind liquid filters enclosed within hemispherical quartz walls. Consistent results proving the presence of antirachitic rays of wave-lengths between 3,000 A. and 3,200 A. were found immediately beneath the surface, the rate of extinction in fairly clear sea water being about 35 per cent per decimetre, so that already in a depth of one metre the intensity is reduced to between 1 and 2 per cent of its surface value. These results, apparently the first obtained with submarine ultra-violet light, have been confirmed by biological tests, in which preparations of 7-dehydro-cholesterol were exposed to sub-surface light behind transparent quartz disks at depths varying between 5 cm. and 1·5 metres.

Shortly before the outbreak of the War, at the request of the International Council, the work on the standardization of rectifying cells used for submarine photometry was transferred from Copenhagen to the Oceanografiska Institutet in Göteborg. In collaboration with Mr. H. Olsson of the Meteorological Office in Stockholm, Dr. Johnsson has worked out a practical method[5] for standardizing the cells by means of sunlight, as originally proposed by Dr. A. Ångstrøm. More recently, Kullenberg and Johnsson have been able to work out a simple method for converting the photo-current readings of submarine daylight into energy-values by means of conversion factors, suited to different conditions of surface illumination and of water transparency. Except in the very uppermost layers, less than 1 metre thick, where deviations due to infra-red radiation, etc., are somewhat larger, the results are assumed to be accurate to a degree corresponding to an error of only 0·25 metre in the depth, which is quite satisfactory for biological as well as for most geophysical purposes. Future light-measurements from oceanographic cruises and stations will become much simplified and the results comparable *inter se* thanks to this method. A standard transparency meter for sub-surface measurements has been constructed by Dr. Johnsson[6].

Work by the author and Kullenberg on improved core-samplers for marine sediments has made satisfactory progress[7], the longest cores hitherto obtained aving a length of nearly eighteen metres. This new echnique will have to undergo severe tests in much reater depths than those at present accessible (240 etres) before it can be recommended for deep-sea ork. Cores with perfectly undisturbed varves from the stuary of Indalsälven, Gulf of Bothnia, have been obained by one of the new core-samplers by Kullenberg[8].

Measurements of the radium content of deep-sea eposits and of manganese nodules from the *Chalnger*, the Monaco and Agassiz collections have been ade by the author[9]. The fall-off in radium content ith the depth below the nodule surface indicates a ate of growth of about 1 mm. in a thousand years r manganese nodules from the Pacific Ocean, an ncreased rate of growth in an upward direction eing interpreted as probably due to sedimentation t the rate of 0·5 mm. in a thousand years. The eautifully regular decrease in radium content with epth below the sediment surface, found by Piggot nd Urry in long cores from the Atlantic Ocean[10], eems to confirm the suggestion offered by the author n 1937[11], that a precipitation of ionium together with erric hydroxide occurs in the ocean and gives rise o part of the radium entering into the sediment, at he same time depleting the ocean water by about 0 per cent of the radium, which would correspond o its uranium content, about $1{\cdot}3 \times 10^{-6}\ {}^{0}/_{00}$ according o B. Karlik[12]. From measurements of thorium in he red clay, made here by Dr. F. Koczy, it can be nferred that thorium also has been very thoroughly xtracted from the water by the same *Mitreissreaktion*, the thorium content in the water being less than $0{\cdot}5 \times 10^{-8}\ {}^{0}/_{00}$, as compared with an earlier value for the upper limit of $0{\cdot}5 \times 10^{-6}\ {}^{0}/_{00}$ found by E. Foyn and E. Rona[13].

A special study of the manganese and iron present in deep-sea sediments, made by the author[14], provides important evidence against the hypothesis of a biological extraction from the sea water of these elements and their subsequent deposition on the bottom together with the foraminiferic shells, recently revived by W. Correns[15]. On the other hand, an extraction of the manganese present in the water through adsorption on very fine particles of volcanic ash, settling slowly through the water, does not appear improbable. The very pronounced local variations in the iron and, especially, in the manganese content of deep-sea sediments may be due to submarine volcanism, the deep-seated magma ejected over the ocean floor being presumably richer in manganese than continental basalts. The same agency, submarine volcanism, the author also holds to be at least partly responsible for the disappearance of the calcium carbonate from the red clay, due to mineral acids released in the reaction between the hot magma and the bottom water. If cold bottom water were the only lime-dissolving agency there ought to be no red clay below 1 or 2 metres from the sediment surface, owing to the higher temperature during the Tertiary age; a conclusion open to future tests by means of the new core-sampling devices.

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[1] *Medd. Oc. Inst.*, No. 1 (1939).
[2] *Sv. H.B.Komm. Skrifter, Hydr.*, 6 (1942).
[3] *Medd. Oc. Inst.*, No. 2 (1939).
[4] *Nature*, 153, 483 (1944).
[5] *Comm. Statens Met. Hydr. Anst. Sthlm.*, No. 47 (1944).
[6] *Sv. H.B.Komm. Skrifter Hydr.*, 19 (1944).
[7] *Medd. Oc. Inst.*, No. 5 (1941).
[8] *Geol. Fören. Förh. Sthlm*, 66, 501 (1944).
[9] *Medd. Oc. Inst.*, No. 8 (1944).
[10] *Amer. J. Sci.*, 38, 81 (1941).
[11] *Wien. Anz.*, 16, 1 (1937).
[12] *Medd. Oc. Inst.*, No. 2 (1939).
[13] *Medd. Oc. Inst.*, No. 2 (1939).
[14] *Medd. Oc. Inst.*, No. 9 (1945).
[15] *Göttinger Akad. Nachr.*, 5, 219 (1941).

CERATIUM AND MARINE HYDROGRAPHY

THE recognized importance of the study of plankton distribution in relation to marine hydrography has called forth a number of intensive investigations in recent years. Three reports* dealing with the distribution of the dinoflagellate genus *Ceratium* are of special interest in this connexion owing to the widespread representation of this genus in all oceans. The important conclusions reached by Graham and Bronikovsky from the examination of the *Ceratium* material gathered during the last cruise of the *Carnegie* in 1928–29 are briefly summarized in the following paragraphs. The survey deals not only with wide areas of the Pacific, but also with the North Atlantic; and, on the basis of the *Ceratium* floras, five regions are distinguished, namely, cold North Atlantic, warm Atlantic, cold North Pacific, warm Pacific and south-east Pacific. These regions are also characterized hydrographically.

Among the factors determining the horizontal distribution of *Ceratium*, temperature plays a foremost part. Apart from a few cosmopolitan (for example, *C. fusus*, *C. horridum*) and subpolar species (for example, *C. arcticum*, *C. lineatum*), the bulk are regarded as tropical. The latter are, however, grouped as species intolerant of colder water and rather closely confined to surface temperatures of 19° C. and above (for example, *C. breve*, *C. lunula*), as slightly tolerant of colder water (for example, *C. contortum*) and as very tolerant tropical species, such as *C. massiliense* and *C. hexacanthum* (*cf.* below). In the opinion of the authors there are no species distinctive of temperate latitudes, such being populated by tolerant tropical and cosmopolitan, with occasional sub-polar, forms.

The influence of the amount of nutritive salts (based on phosphate-determinations) is less easily assessed. Regions of very low phosphate content (for example, the warm Atlantic) are in general characterized by a scanty *Ceratium* flora comprising a large number of species, while those with a high content (for example, the North Atlantic and the North Pacific) tend to be more densely populated by a restricted number of species. There is, however, no exact correlation, and the authors conclude that the phosphate-content has no considerable effect on the horizontal distribution of the species of *Ceratium*, although in a given area relative values may be of some significance. Nielsen's view that the concentration of organic products derived from the plankton is an important factor in determining the distribution of *Ceratium*, a view based principally on the distribution of neritic and oceanic forms, is briefly considered but no data for or against the theory are provided.

The probable value of species of *Ceratium* as current indicators could not be very fully assessed in a gross survey like that undertaken by the *Carnegie*. Currents displace both the flora and its environment, so that species can exist in regions which are unfavourable to them until, by mixing with the adjacent water, that of the current becomes unsuitable and the species disappears. Good examples of displacement by currents are furnished by the tolerant tropical species. Thus, the Gulf Stream carries *C. extensum* to the British Isles (surface temperatures 12·4° C.) and *C. hexacanthum* to Iceland (surface temperatures 8·9° C.), although elsewhere these two species are not found at temperatures below 14·9° and 18·9° C. respectively. It does not appear that the equatorial currents appreciably affect the distribution of species of *Ceratium*.

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* Peters, N., "Die Bevölkerung des südatlantischen Ozeans mit Ceratien", Wiss. Ergebn. Deutsch. Atlant. Exped. *Meteor*, 1925–7, 12 (1932); Nielsen, E. S., "Untersuchungen über die V breitung, Biologie und Variation der Ceratien im Südlichen Stillen Ozean", *Dana* Report, No 4 (1934). Graham, H. W., and Bronikovsky, N., "The Genus *Ceratium* in the Pacific and North Atlantic Oceans", Scient. Res. Cruise VII *Carnegie* (1928–9), etc. Carnegie Instit. Washington, Publ. 565 (1944).

Comparison of the *Ceratium* floras of the two great oceans shows that only eight of the fifty-eight species recorded are restricted to one ocean only and that is always the Pacific. The species in question (*C. deflexum*, *C. bigelowii*, etc.) are either strictly tropical or only slightly tolerant of colder waters, and the seas around Cape Horn may form an impassable barrier to their extension into the Atlantic. Certain differences in the distribution of species common to the two oceans suggest that there may be greater differences between their *Ceratium* floras than is at present apparent. Thus, although the North Atlantic and the North Pacific resemble one another in the occurrence in both of the subpolar *C. lineatum* and *C. arcticum*, there are striking differences which suggest biological isolation. *C. pentagonum*, a species widespread in the tropical seas of both Oceans, is absent from the North Atlantic while represented in the North Pacific by the very divergent subspecies *pacificum*. Again *C. macroceros*, with the subspecies *gallicum* frequent in all warm-water regions, is represented in the North Atlantic by the sub-species *macroceros*, though lacking in the North Pacific.

Twenty of the recorded species (for example, *C. praelongum*, *C. tenue*) show an increase in frequency from the surface to 100 metres. Such species have thin cells crowded with chromatophores which also extend into the horns when these are present. On the whole there is considerable agreement between the *Carnegie* data and those of Nielsen as regards these 'shade' species. The authors of the *Carnegie* Report, however, suggest that, apart from attunement to shade conditions, such forms may tend to move into layers of the water with a richer supply of nitrates and phosphates than are to be found in the surface layers at times of high plankton production.

F. E. FRITSCH.

CARNEGIE TRUST FOR THE UNIVERSITIES OF SCOTLAND

THE forty-third annual report of the Carnegie Trust for the Universities of Scotland covers the academic year 1943–44, and includes a summary of the interim distribution of grants for the period October 1, 1943–September 30, 1944, with details of assistance to students and the abstract of financial accounts for the year ended September 30, 1944. In view of the continuation of war conditions, the Committee deemed it inexpedient to revert to the method of quinquennial distribution, and maintained the interim distribution on the same basis as previously. With regard to research, the situation was very similar to that recorded in 1942–43 and the abstract of accounts shows that a sum amounting to £15,497 has been accumulated, which is being held on behalf of fellows and scholars at present engaged on one or other form of national service, and of recipients of grants who have now been unable to make use of their awards. As it is unlikely that all those who have been awarded fellowships or scholarships since the outbreak of war will elect to begin or resum their researches under the ægis of the Trust, it possible that a substantial reserve will have bee created for the development of the Trust's plans fo aiding research.

The decline in the number of beneficiaries was mo marked in the Faculty of Arts where there were 1 less than in the previous session. The decline of in science on the figure for the previous session w more than offset by a sharp rise in the number beneficiaries in the Medical Faculty, the increase medicine being 80 over the previous year. It essential that it should be made known as widely possible that, unless in the future the number of th beneficiaries falls very considerably, the resources the disposal of the Trust will not permit any additio to the amount at present given by way of assistan in the several faculties.

The report on the work of investigators under th research schemes during the year referred to Mr E. M. Gorgeson's work on the flow of fluids through per forated tubes and through tubes the walls of whic offer little resistance to diametrical expansion. Tribut is paid to the achievements of Dr. Hwan-Wu-Peng i a new approach to the quantum theory of field Researches in geology, palæontology and geograph have been still more restricted, and during the perio scholars in chemistry, with few exceptions, held the scholarships in suspense pending a return to academ studies. Reference, however, is made to Mr. A. M Mathieson's work on the comparison of the structur of certain sulphur compounds, to Mr. A. C. Docherty' work on thermal diffusion in liquids and relate systems and to Mr. W. Graham's discovery of greatly improved method of obtaining a degradatio product of colchicin of primary importance in relation to the structure of this alkaloid, and hi synthesis of a new hydrocarbon with five condense benzene nuclei attained by fusing an additiona benzene ring on to the chrysene molecule.

In the Biological and Medical Sections reference i made to Dr. G. Pontecorvo's work on the behaviour of the chromosomes of the germ cells in securing transmission of the normal hereditary constitution, while yet providing for transmission of slight intrinsic variations of the genes, which afford the opportunity for the operation of natural selection and thus for the possible production of mutant forms. Dr. L. Auber continued to investigate the influence of physical and chemical factors upon the meal moth, and Mrs. C. M. Ritchie her investigations on carbohydrate metabolism in collaboration with Dr. H. W. Kosteritz. A list of publications by fellows and scholars and recipients of grants received from September 30, 1943, is appended.

The report of the Laboratory of the Royal College of Physicians, which includes some reference to Dr. Edith K. Dawson's investigations on the sarcoma of the breast and on another rare neoplastic condition. In the field of biochemistry under Dr. W. O. Kermack important progress has been made in the synthesis of various *o*-phenanthroline derivatives substituted in the 2-position by basic side-chains similar to those present in such active compounds as mepacrin or plasmoquin, and effort has now turned to the synthesis of *o*-phenanthrolines substituted in the 9 or 10 position. Mr. Jacomb has concentrated on the preparation of analogous compounds to give *p*-phenanthroline derivatives with a basic side-chain in position 9 or 10 on the benzene ring instead of in the 2-position. 9-Bromo-*p*-phenanthroline has been prepared and adily converted into amino-phenanthroline under nditions described by R. V. Haworth and W. O. kes. Before Mr. Dobson left the laboratory at the d of September, he had made excellent progress in e synthesis of pyridoacridine derivatives carrying sic side-chains of various types, some of which had ven very promising results on biological tests. Some ogress had been made in the related group of the nzacridines, some of which are also active. The rk on the pyridoacridines is being continued by r. Hutchison, who has concentrated on the synthesis compounds with various substituents in the icleus. Further evidence has been obtained of the rrectness of the assigned structure of the 4-hydroxy- -phenanthroline synthesized by Dr. Tebrich. Dr. ggleton and Dr. Kermack have also continued their athematical work on problems of diffusion such as e encountered in connexion with the diffusion of mpounds into and out of the tissues, and under Dr. evinthal experimental work for the development of general bacteriological medium is being pursued.

UNIVERSITIES AND THE NEEDS OF THE COMMUNITY

UNDER the title "Some Comparisons between Universities", the proceedings of the Second ducation Conference of the Association of University rofessors and Lecturers of the Allied Countries in reat Britain have now been published*. The report icludes a summary of the proceedings by Prof. R. D. aurie and a foreword by Sir Ernest Barker which mphasizes the wide range of thought which was ooled at the Conference. None of the British niversities and none of the Western universities ave, as Prof. E. Vermeil noted in an address n "The University Spirit in Germany and in the Vestern Democracies", succumbed to the domination f a political dogma, and similarly, as Mr. Willard onnely reminded the Conference, American univer- ities were among the first in the United States to ee the inevitability of American participation in the vorld struggle for freedom.

The report gives indeed an encouraging picture of he influence of the university on society which should be remembered when we are considering some current riticism of the universities. Mr. Connely can ightly point to such presidents of American niversities as Lowell and J. B. Conant, who ontended that universities must counteract rather than copy the defects of contemporary civilization, and have helped to make the American university a main instrument of fostering an international outlook. Sir Ernest Barker too refers to the strength which we can draw in facing the future from looking back on the past achievements of our universities and their contribution to religious life and national culture. The tradition of unselfish learning and the inheritance of national culture, which the ancient universities of Europe have steadily sought to accumulate and transmit from generation to generation, will be sorely needed as we face the task of reconstructing European society, and whatever changes or developments may be called for should not be such as to weaken that tradition or the love of learning, the passion for research and for teaching which have flowered in that old, rich and deep soil.

That the comparisons between universities made in this report leave first of all a deep impression of common traditions and ideals does not necessarily invalidate certain criticisms and suggestions for improving contacts made at the Conference. Prof. Jean Timmermans, who remarked on some points in which British practice in the organization of scientific research might be adopted on the Continent, believes that the exchange of scientific publications between Great Britain and the Continent is on an insufficient scale, and suggested a wider distribution of European periodicals in British universities. He also believes that there is a tendency to insularity in British universities, and that contact with them before the War was difficult. It was necessary to approach each university separately, and from this point of view he welcomed the proposal for a university council contained in the recent report of the British Association's Committee on Post-War Education.

Contacts are not entirely lacking, but Prof. Timmermans' view should be duly noted in considering the re-organization of the universities of Britain and their development to meet the larger demands both for teaching and research which will be made upon them in the immediate future. So too should the important point made by Sir Fred Clarke, in speaking on "The University and the Teaching Profession", that a university is scarcely entitled to prepare students for any profession unless within its walls the problems of that profession are being systematically studied. The condition is reasonably well fulfilled for such professions as medicine and engineering; but it is only beginning to be fulfilled in that of teaching—or, it might be added, of law. Again, the university is above all the guardian of standards, standards both of teaching and of attainment, in students, and no point will require more careful watching in these immediate post-war years.

On some of the other points of criticism expressed at the Conference there was less general agreement, and the suggestion in Mr. Bruce Truscot's paper on "Contact with the Student Mind" that a wide gap exists between the professor or lecturer and the student was not supported either by Prof. R. D. Laurie, who presented the paper, or by Sir Ernest Barker or by others: Mr. S. Grzybowski, a student of the Polish Medical School in Edinburgh, for example, was impressed by the closeness of the relation between the professor and the students. While Mr. Truscot's suggestion for the improvement of contacts between the university and the school was not entirely acceptable, the Conference appeared to recognize that it is important to strengthen that contact as much as possible. Again, Prof. Vaucher thought that the Continental scholar would be most impressed by the tutorial system in the older universities of Britain and the supervisor system in the newer ones; and Mr. Grzybowski thought that the British system is better for the average student, whereas the system of many Continental universities gives a better chance to the best students.

The relative position of teaching and research in the universities was just touched upon at the Conference without going deep enough to add anything to the present debate. Mr. Grzybowski thought that it is more commonly recognized in Britain than in some Continental universities that much the most important duty of the university staff is teaching.

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* Association of University Professors and Lecturers of the Allied Countries in Great Britain., Second Education Conference, April 15, 1944: Some Comparisons between Universities Pp xvi+64. (Oxford: Basil Blackwell, 1944) 2s. 6d. net.

On the whole, it must be admitted that the four papers contributed at the session on research, apart from Prof. Timmermans' appeal for fuller exchange of scientific publications, and Prof. G. I. Finch's plea for British assistance to universities and research schools on the Continent in the form of interchange of apparatus and workers and teachers as well as literature, contributed little fresh. Dr. M. Ruhemann, in a paper on the organization of research in the U.S.S.R., while urging that organization is only a means to an end, never an end in itself, believes that some combination of a political, an economic and a scientific body is fundamental in order that research may be organized effectively on a national scale. To organize science without taking into consideration the economic needs of the country would lead to a divorce of science from the life of the people, and thus to a lifeless and scholastic science, while the organization of national economy without some political directive might be impossible.

More vital, on the whole, than the sessions on research and on teaching in the universities were those concerned with the influence of the university on the student and the influence of the universities on society. In the former, Miss M. R. Gale, secretary of the International Council of Students in Great Britain, and of the National Union of Students, stated that the students' union is a most important factor in training students in committee work, public speaking, and similar activities fitting them to take part in public life. Some Continental speakers remarked on a distinct gap between the student body in Great Britain and the rest of the community. Mr. J. L. Henderson, general secretary to the British Committee of World Student Relief, in speaking of what is already being done in this field of student relief and of the plans of the British Committee of World Student Relief for developing post-war activities, indicated at the same time one way of re-integration of student life with that of the community. He foresees during the post-war years a tendency among students to political apathy, frivolous irresponsibility, as well as to hatred and despair, especially among those who can appreciate most clearly the inadequacy of the political conditions which surround them. To rekindle the flame of true scholarship, to re-create moral values and spiritual principles may perhaps be done best by working empirically from the bonds which necessity in the shape of famine and disease has forged between all sorts of men holding all sorts of rival opinions. The immediate need in centres such as Vienna, Prague, Warsaw or Belgrade will be the establishment of student committees of self-help to plan and control, in association with whatever foreign assistance may be available, the relief work among local university students.

Mr. Henderson's plea for an act of imagination and faith, to restore student life to a worthy place in the community, was in keeping with the high note that was generally struck at the Conference. There was no disposition to ignore the fact that the Western universities have enemies. They were clearly enunciated by Prof. E. Vermeil as specialization, mechanization of learning and undue interference by the State; and Prof. Vermeil developed something of the argument of Mr. A. S. Nash in his book on "The University in the Modern World" which appeared after the Conference. The Western tradition of humanism, resting on the Greco-Latin humanities, on certain elements in Christianity, on the liberalism of the eighteenth century and the social spirit of t nineteenth, has always regarded the university as t chosen soil for the unimpeded growth of scienti research and culture. But the plans for universi reform, for the shaping of Western universities that they may serve more effectively the needs to-day, will come to nothing unless they are bas on a renewed conception of the university spirit, general culture and its role in the democracies to-morrow.

No one would pretend that this Conference made fundamental contribution to the evolution of a n philosophy of the university, but it at least points some of the fundamental questions that have to faced, to some problems where practical action mig easily be taken. In such thinking, it is no sm matter to have this evidence that the problems university expansion and its relation to the needs the community, to which so much thought h already been given in Great Britain, are problems which the best minds of Western Europe and t United States have also been exercised, that t great traditions of university life are held in comm with them, and that from their experience also may draw both guidance and inspiration.

TUNAS OF THE PACIFIC*

FOUR species of *Tuna* play an important part the fisheries of California, Mexico and Centr America: the skipjack *Katsuwonus pelamis* (Lin æus), the yellowfin tuna *Neothunnus macropter* (Temminck and Schlegel), the albacore *Thunn germo* (Lacépède) and the bluefin tuna *Thunn thynnus* (Linnæus). The big-eyed tuna *Parathunn mebachi* (Kishinouye) was also investigated and con pared with the others. The present study was unde taken in March 1940, to determine the geographic range of these and the relationships between the and similar species occurring in the Central, Wester and Equatorial Pacific. This entailed a detaile anatomical treatment which will form a firm founda tion upon which investigations may be extended int lines more directly applicable to conservation.

The work has shown concerning the skipjack tha within the entire fishing area in the Eastern Pacif extending along the Central and North America coast-line from the equator to California and offshor to include all the outlying islands, there is but single species, and specimens from all these area are furthermore individually indistinguishable fron those obtained from Japan and the Hawaiia Islands.

In the case of the yellowfin tuna, again there i a single species throughout the fishing area, and thes fish are individually indistinguishable from th specimens obtained from the Hawaiian Islands, Japa and Peru. Distinct populations may exist within thi larger area, but conclusions concerning these awai the analysis of data collected.

The albacore of the North American coast-lin proved to be the same species as that from Japa and the Hawaiian Islands, with a geographical dis tribution extending across the north temperat Pacific.

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* A Systematic Study of the Pacific Tunas. By H. C. Godsil an Robert D. Byers. (Bureau of Marine Fisheries, California Division o Fish and Game · State of California Department of Natural Resources Division of Fish and Game, Fish Bulletin No. 60.) (Sacramento California State Printing Office, 1944.)

he bluefin tuna from southern and lower California essentially one species and, until adequate de- ptions are available from all localities, must be gned to the same species as *Thunnus thynnus* of Atlantic. Lacking material from Japan, com- ison with Kishinouye's (1923) description of *nnus orientalis* (the oriental bluefin) shows that is probably a different species.

Vith regard to the chief morphological features, it found that the appearance of the viscera ***in situ*** valuable identifying character. Other differences ear in the presence or absence of air bladder, erences in excretory system, and the circulatory tem which is unique in many respects. The differ- es in circulatory system were used by Kishinouye classifying the tunas. The present observations re confined largely, but not exclusively, to the erial system. The post-cardinal vein is present in but the genus *Thunnus*, but its course and degree development differ. The skeletal elements are arkably alike, and the authors believe that they r less promise for specific identification than other tomical parts. Nevertheless a key is given to five species studied, based on these skeletal ments; also a table giving a summary of tomical differences.

n the most important characters the skipjack fers from all the others. Alone it can be distin- ished at once by the external features. It lacks air bladder. The intestine is not folded. The ntral view of the viscera ***in situ*** is distinctive and ferentiates it. In its blood system and excretory tem it differs sharply from the others. It is the iest to identify of the five species.

Foreseeing the necessity of a more detailed popula- n study of some species, a large number of both ternal and internal measurements and counts were ded to the routine. These are reserved for a future rk.

A METEORIC THEORY OF THE ORIGIN OF THE EARTH AND PLANETS

D. J. SCHMIDT has a paper with this title in *Comptes Rendus* (*Doklady*) *de L'Académie des iences de L'URSS*. (**45**, No. 6; 1944), in which he opounds a new theory of the origin of the planetary stem. At the basis of the theory there are two ndamental facts—the rotation of the Galaxy and e presence near its central plane of large masses of oscuring matter. During its motion round the ntre of gravity of the Galaxy, the sun crossed a ark cloud of dust and meteorites and captured ortions of this, compelling the particles to revolve round its centre. In the course of time these cap- red particles united into larger formations, thus roducing the planets.

In a previous paper (*C.R. Acad. Sci. URSS.*, **44**, o. 1; 1944), the author dealt with the formation f binaries in a rotating Galaxy. The motions of tars are a combined result of the attraction of the entral galactic masses and of external masses and he neighbouring individual stars, and under certain onditions two stars can come into such a position hat they are drawn closer together, so that capture nd the formation of a double star occur. The ollowing assumptions, considered to correspond to tatistical averages, were made in dealing with this problem: (*a*) The stars move along circular orbits, subject to the attraction of the Galaxy, supposed to be concentrated in its centre. (*b*) The orbits lie in different planes inclined at small angles to one another. (*c*) Capture takes place when the two stars pass the position of the shortest distance between the orbits.

On these assumptions, a formula has been derived which connects the semi-major axis and eccentricity of the orbit of the binary with a quantity which depends on "the galactic parameter of the stars". This is a function of the distance to the galactic centre, the mass of the inner portion of the Galaxy, the total mass of the two stars, and the angle between the orbital planes of the stars previous to capture. While the formula is not strictly applicable in every case, as it considers mean results, nevertheless it is sufficiently accurate to apply to the problem of the capture of meteoric matter by the sun.

It is essential to the theory that the plane of the sun's galactic orbit should be inclined at an angle of about 3° to the central plane of the Galaxy. If the sun while at one of the nodes of its orbit passes through a cloud of matter, meteorites are captured in accordance with the same laws as underlie the formation of double stars. Both direct and retrograde motions take place with the captured meteorites; but if the sun passes near the edge of the cloud its density is not uniform, and in consequence more meteorites revolve in one direction about the sun. Those revolving in the opposite direction collide with the more numerous portion of the swarm and lose their momentum, ultimately falling into the sun. The main mass segregates in the course of time into larger bodies from which the planets are formed, and this segregation proceeds through smaller particles falling on larger ones just as meteorites fall on the earth at present. As the swarm of meteorites has the form of a flat lens, the planets in the process of formation have their orbits lying approximately in one plane—the central plane of the lens—and as the meteorites ultimately revolve in one direction, for reasons already suggested, the planets will also revolve in one direction. In the early stage the major axes of the swarm have a tendency to distribute their axes along the shortest distance between the galactic orbit of the sun and that of the cloud, but they are deflected from this direction by mutual perturbations. Hence no planet formed in the manner suggested can have a preferential direction for its major axis.

The problem of the angular momenta of the planets, which has been an insuperable difficulty with many theories of the formation of the solar system, is avoided by the present view, as the galactic momentum of the meteorites supplies the necessary angular momenta. Dr. Schmidt hopes that the theory will be further developed to bring within its scope such problems as the rotation of the sun and of the planets, the age of the planetary system, the formation of the satellites, etc. In addition, certain features concerning the internal structure of the earth are explicable, and Dr. Schmidt is engaged in the preparation of papers which will discuss such problems. The present paper contains some quantitative results regarding the distribution of mass and momentum in the planetary system and also the extent of agreement between the theory and observational evidence. These are largely provisional, and additional evidence in support of the theory will be forthcoming in the papers which are to be published in due course.

FORTHCOMING EVENT

Tuesday, August 14

Quekett Microscopical Club (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 7 p.m.—Conversation and the Exhibition of Specimens.

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Senior Irrigation Engineers for the Directorate-General of Irrigation, Iraq—The Ministry of Labour and National Service, Appointments Department A.9, Room 670, York House, Kingsway, London, W.C.2, quoting E.1817.A (August 17).

Technical Superintendent of the Blackburn Electricity Undertaking—The Engineer and Manager, Electricity Offices, Jubilee Street, Blackburn (August 18).

Lecturer in Mathematics, and a Lecturer in Natural Philosophy in the United College, St. Andrews—The Secretary, The University, St. Andrews (August 18).

Provincial Advisory Chemist in the Department of Agriculture and Horticulture—The Secretary and Registrar The University, Bristol (August 18).

Lecturer in Mechanical Engineering—The Registrar, College of Technology, Manchester 1 (August 20).

Assistant Master to take Physics and Chemistry—The Principal, Enfield Technical College, Queensway, Enfield, Middx. (August 20).

Lecturer in Chemistry at the Widnes Municipal Technical College—The Divisional Education Officer, Town Hall, Widnes, Lancs. (August 24).

Technical Assistant in Agricultural Economics—The Acting Registrar, The University, Leeds (August 24).

Borough Electrical Engineer and Manager—The Town Clerk, Municipal Offices, Grimsby, endorsed 'Borough Electrical Engineer and Manager' (August 24).

Gas Research Fellowship of the Institution of Gas Engineers tenable at the University of Leeds—The Assistant Clerk to the Senate, The University, Leeds (August 25)

Deputy Borough Engineer and Surveyor—The Town Clerk, Town Hall, East Ham, London, E 6 (August 25)

Assistant Lecturer in International Relations—The Secretary, London School of Economics, Houghton Street, Aldwych, London, W.C.2 (August 27).

Lecturer in Biochemistry, an Assistant Lecturer in Biochemistry, and a Demonstrator in Physiology—The Acting Registrar, The University, Leeds 2 (August 27).

Deputy General Manager and Engineer to the Sheffield Corporation Electricity Department—The Town Clerk, Town Hall, Sheffield 1 (August 28).

Assistant Engineer to the Nigerian Electric Supply Corporation, Ltd.—The Ministry of Labour and National Service, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting D 1297.XA (August 29).

Assistant Lecturer and Demonstrator in Engineering—The Registrar, University College, Cathays Park, Cardiff (August 30).

Lecturer in Agricultural Economics, and an Assistant Lecturer in Agriculture, at the Essex Institute of Agriculture, Writtle, near Chelmsford—The Chief Education Officer, County Offices, Chelmsford (August 31).

Probationary Assistant Lecturer in Economics (specially qualified in Statistics)—The Acting Registrar, University College of North Wales, Bangor (August 31).

County Organizer of Young Farmers' Clubs—The Acting Secretary, North Riding Federation of Young Farmers' Clubs, The Court House, Northallerton, Yorks (August 31).

Research Physicist, Division of Radiophysics, Sydney—The Secretary, Australian Scientific Research Liaison Office, Australia House, Strand, London, W C.2 (August 31).

Editor of the publications of the Chemical Society—The Hon. Secretaries, Chemical Society, Burlington House, Piccadilly, London, W.1 (September 3).

Registrar—The Registrar, University Registry, Cathays Park, Cardiff (September 8).

Professor of Aerodynamics, a Professor of Aircraft Structures, Engineering and Design, and a Professor of Engines and Systems of Propulsion—The Secretary to the Board of Governors, College of Aeronautics, 14 Belgrave Square, London, S.W.1 (September 15).

Registrar, and an Assistant Registrar and Bursar—The Secretary to the Board of Governors, College of Aeronautics, 14 Belgrave Square, London, S.W.1 (September 15).

Lecturer in Geography, and a Lecturer in Zoology, in the Natal University College, Pietermaritzburg—The Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1 (September 15).

Lecturer (specially interested in Physical Metallurgy) in the Department of Metallurgy—The Registrar, The University, Sheffield (September 15).

Lecturer in Mathematics—The Secretary, Queen's University, Belfast (September 30).

Master of Method and Lecturer in Science and Mathematics at the Edinburgh Training Centre (Moray House)—The Executive Officer, 140 Princes Street, Edinburgh (October 10).

Lecturer in Inorganic and Analytical Chemistry—The Secretary, The University, Aberdeen (October 15).

Chair of Metallurgy tenable at the Imperial College of Science and Technology—The Academic Registrar, University of London, Richmond College, Richmond, Surrey (October 31).

Librarian of Auckland University College, Auckland, New land—The Secretary, Universities Bureau of the British Em c/o University College, Gower Street, London, W.C.1 (December 1

Technical Assistant—Chief Engineer, Newcastle and Di Electric Lighting Co., Ltd., 81 Westgate Road, Newcastle-upon-T

Area Supervisor (home-based, to live in the Newport, Shrops area), and an Assistant Area Supervisor (to live in the War area), under the National Milk Testing and Advisory Scheme—Principal, Harper Adams Agricultural College, Newport, Shrops.

Assistants (male) for Petroleum Laboratory work and operation of small experimental plants on shifts—The Ministr Labour and National Service, Appointments Department, Sar Street, Kingsway, London, W.C.2, quoting Q.N.410.

Indexer and Abstractor of technical publications in the Mi Resources Department—The Establishment Officer, Imperial Insti South Kensington, London, S.W.7

Lecturer in Inorganic and Physical (Pharmaceuti Chemistry—Prof. W. H. Linnell, College of the Pharmaceu Society, 17 Bloomsbury Square, London, W.C.1.

Radium Custodian (woman)—The Clerk to the Governors, Bartholomew's Hospital, London, E C.1.

Forester (practical, experienced, working) for the Isle of M The Secretary, Isle of Man Forestry Board, Atholl Street, Dou Isle of Man.

Assistant Lecturers (temporary) in Zoology—The Secret University College, Gower Street, London, W.C.1.

Teacher (well qualified) of Chemistry and General Scien The Principal, Technical Institute, Tunbridge Wells.

Lecturer in Mechanical Engineering—The Secretary, W wich Polytechnic, Woolwich, London, S E 18.

Teacher of Engineering Subjects, and a Workshop Instruc in the Harrogate Technical Institute—The Municipal Officer, Ha gate.

Lecturer in Hygiene and Applied Science—The Princ Normal College, Bangor, North Wales.

REPORTS and other PUBLICATIO

(not included in the monthly Books Supplement)

Great Britain and Ireland

Medical Research Council. War Memorandum No. 15: The Steril tion, Use and Care of Syringes. By a Committee appointed by Medical Research Council. Pp. 24. (London: H.M. Stationery Of 1945.) 4*d.* net. [

The Journal of Documentation: devoted to the Recording, Org ization and Dissemination of Specialized Knowledge. Publi quarterly. Vol. 1, No. 1, June 1945. Pp. 64. (London: Associat of Special Libraries and Information Bureaux, 1945.) 7*s.* 6*d.*; S scription, 25*s.* a year. [

Empire Cotton Growing Corporation. Progress Reports from periment Stations, Season 1943–1944; Programmes of Experime Season 1944–1945. Pp. ii+176. (London: Empire Cotton Grow Corporation, 1945.) 3*s.* [

King Edward's Hospital Fund for London. Second Memorand on Hospital Diet: for Consideration by Hospitals. Pp. 60. (Lond Geo. Barber and Son, Ltd., 1945.) 9*d.* net. [

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Mémoires du Musée Royal d'Histoire Naturelle de Belgique. Ta Analytique des Mémoires 1 à 100 (1900–1943). Par Maxime Glib Pp. 72. Mémoire No. 91: Les goniatites du Dinantien de la Belgiq Par G. Delépine. Pp. 94+5 plates. Mémoire No. 92: Les echinoderm du frasnien de la Belgique. Par Eug. Maillieux. Pp. 47+3 plat Mémoire No. 94: La flore et la faune du Bassin de Chasse d'Osten (1937–1938). Par E. Leloup. Pp. 122+3 plates. Mémoire No. 9 Recherches sur les eaux saumatres des environs de Lilloo, 1. Étu des milieux. Par W. Conrad. Pp. 97+5 plates. Mémoire No. 9 Les Brachiopodes de l'Emsien de l'Ardenne. Par Eug. Maillie Pp. 74. Mémoire No. 97: Faune et stratigraphie de l'Étage Namur de la Belgique. Par F. Demanet. Pp. 327+18 plates. (Bruxelle Musée Royal d'Histoire Naturelle de Belgique, 1940–1944.) [1

Mémoires du Musée Royal d'Histoire Naturelle de Belgique. Mémo No. 98: Recherches sur quelques nématodes parasites de poissons la Mer du Nord. Par A. Punt. Pp. 110. Mémoire No. 99: Sur la fau et la flora d'un Ruisseau de l'Ardenne Belge. Par W. Conrad. P 177+2 plates. Mémoire No. 100: Palmoxylons Paniséliens de Belgique. Par Yvonne Willière, Pp. 78+10 plates. Mémoire No. 10 Les horizons marins du Westphalien de la Belgique et leurs faunes. P Felix Demanet. Pp. 166+9 plates. Mémoire No. 102: Recherch sur les triclades dulcicoles épigés de la Foret de Soignes. Par Eugè Leloup. Pp. 112+3 plates. (Bruxelles: Musée Royal d'Histo Naturelle de Belgique, 1940–1944.) [1

The Application of Science to Industry in Australia. By Sir Dav Rivett. (The John Murtagh Macrossan Memorial Lectures for 194 Pp. 48. (Brisbane: University of Brisbane, 1944.) [2

Indian Lac Cess Committee. Annual Report for the Year 1st Apr 1943 to 31st March, 1944. Pp. 43. (Ranchi: Indian Lac Cess Co mittee, 1945.) [2

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University of Denver: Department of Anthropology. Archæologic Series, Fifth Paper: Archæological Survey of South Park, Colorad By Prof. E. B. Renaud. Pp. 20. (Denver, Colo.: University Denver, 1945.) [2

Institut de France: Académie des Sciences. Annuaire pour 194 Pp. 211. Annuaire pour 1943. Pp. 211. Annuaire pour 194 Pp. 215. Annuaire pour 1945. Pp. 223. (Paris: Gauthier-Villa 1941–1945.) [2

NATURE

No. 3955 SATURDAY, AUGUST 18, 1945 Vol. 156

CONTENTS

	Page
he End of the Second World War	187
ohn Tyndall. By The Right Hon. Lord Rayleigh, F.R.S.	189
essel Functions. By Prof. L. M. Milne-Thomson	190
amily Studies in Tuberculosis Control	191
he Child's Blood in Health and Disease. By Prof. T. B. Davie	192
Hitherto Unpublished Letter of Isaac Newton	193
nzyme Activity as a Factor in Insect Physiology and Toxicology. By Dr. H. Hurst	194
bituaries:	
Miss E. R. Saunders. By Miss G. L. Elles and Dame Ethel Shakespear; Prof. J. McL. Thompson	198
Mr. H. E. Potts	199
News and Views	200
Letters to the Editors:	
Penicillin in Leishmania Infections.—J. D. Fulton	203
A Thermostabile, Fungistatic Factor from *Escherichia coli*.—Sten Wiedling	204
A New Occurrence of the Electronic Phase Velocity.—W. E. Benham	204
Chromatography of Two Solutes.—Dr. E. Glückauf	205
Anomalous Inactivation of Heavy Metal Antifouling Paints.—Prof. John E. Harris	206
Amino-quinazolines.—Prof. A. Killen Macbeth and Harold J. Rodda	207
Influence of Sulphur Oxides on the Luminosity of Coal Gas Flames.—Dr. G. Whittingham	207
Distribution of Vanadium, Chromium, Cobalt and Nickel in Eruptive Rocks.—Prof. L. R. Wager and R. L. Mitchell	207
Economy in Sampling.—G. A. Barnard	208
Is Human Speech Good Enough? By Sir Richard Paget, Bart.	209
Chemotherapy of Tuberculosis. By Dr. M. A. Soltys	210
South-Eastern Union of Scientific Societies: Annual Congress, 1945.	211
Carnegie Corporation of New York	212
The Cod	213

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THE END OF THE SECOND WORLD WAR

THE dramatic collapse of Japan under the pressure of unprecedented air bombardment accompanied by the threat of invasion by overwhelming forces marks the end of the War of 1939–45—the Second World War. More than that, it marks the end of a period extending over some thirty-five years which has witnessed increasing social unrest and suffering, culminating in warfare of an intensity never before witnessed, and physical destruction on an appalling scale. War has now become so terrible, so swift in its march and so indiscriminate in its cutting off of old and young alike, that the greater nations of the world must recoil with horror from the possibility of another major war, lest they court annihilation of whole populations. This is not to say that armed forces will be unnecessary; for so long as man falls short of the ideal in his ethical outlook and practice, there will be differences and disputes, some of which may lead to wars. But it should not be beyond the power of the nations, imperfect as man is, to limit the conflict and promote a swift settlement. Towards this end the United Nations Charter is a first instrument, based on a mixture of idealism and worldly practicability, which can be of prime importance for the future of humanity.

Two events of the immediate past will always be associated with the surrender of Japan to the will of the United Nations. These are the use of atomic energy in the form of a bomb of stupendous destructive power, and the declaration of war on Japan by the U.S.S.R. It is idle to speculate on their relative significance, in that both are the result of carefully prepared plans carried out over a long period; and the fact that they came to fruition almost simultaneously may have been a coincidence. In any event, we are more concerned for the moment with the significance of the release of atomic energy in manageable fashion. This, as we have already pointed out (*Nature*, August 11, p. 153), is a landmark in the history of mankind—it marks the beginning of a new era, an era in which the quality of the work of men of science of the world will not only be of immense importance, but will also be acknowledged as such. It is not suggested that men of science should become, as it were, a ruling caste, to whom all others would defer; they themselves would be the first to dispute any such intention, for their training does not of necessity develop the qualities needed for administration. Rather we would anticipate that they will be expected to take a share in the tasks of government, as they have done during the War, at the direct request of the ruling authority and with a conspicuous success which has been generally acknowledged and acclaimed. Gone, it is hoped, are the days when men of science were regarded as useful standbys, to be called in when things go wrong and speedily relegated to the background after use has been made of their knowledge. But scientific workers must also play their part; they must not allow their preoccupation with their particular interests to make them oblivious to their responsibilities as citizens of a world which is becoming increasingly dependent on their efforts, and they must maintain their high standard of integrity.

So far as the general outlook is concerned, the present position as regards scientific and industrial research is very little different from that at the close of hostilities in Europe (see *Nature*, May 12, p. 553). Everywhere throughout the world there are shortages due to sheer destruction, to lack of raw materials, to transport difficulties and so on. There are innumerable problems for men of science to tackle, arising out of war-time conditions; and in addition, there has been a space of six years during which scientific investigation has been very largely diverted from its normal course. Scientific workers will also be called upon in the immediate future in connexion with the control of Japanese scientific and industrial development.

This task will be much the same as in Germany; for Japan is highly industrialized, and the guidance of her industries on to peaceful lines will require equivalent measures. Nor need the difficulty of a language so different in form and structure from those of Western Europe be regarded as an insuperable barrier. Many educated Japanese are familiar with Western languages, and also there is a small number of European scholars who have studied Japanese history and culture and whose guidance will no doubt be sought; further, steps have already been taken to train students who show an aptitude for Oriental languages in readiness for such duties as may devolve upon an occupying body. So far as scientific and industrial processes are concerned, there will be little difficulty; the chemical equation has the same significance, both qualitative and quantitative, in the Far East as in the West, and there is no possibility of shades of meaning; mathematical symbols are equally definitive throughout the world, whether they are used in purely mathematical work or in connexion with aerodynamics, hydraulics, electrical engineering and other applied studies. Scientific research and industrial practices in Japan have come mainly from European and North American sources and employ the same terms and even the same symbols. Thus it is quite common to find a scientific paper written in Japanese but liberally sprinkled with chemical equations printed in Latin characters with Arabic numerals just as in European practice. Even in biology and geology, scientific terms are usually employed directly without translation, and the binomial system of nomenclature of living organisms is as apparent in papers in Japanese on biological topics as are the chemical equations referred to above. Indeed, the language of science, as it is written in Europe and America, is truly international in form and significance.

In devising means of controlling scientific research and industrial and engineering development in Japan, there seems no reason, as has been suggested above, why it should not follow the main lines laid down for the control of Germany, but with the important proviso that policy will be influenced by the counsel of those who are familiar with the Japanese mode of life and cultural tradition. It would be absurd to attempt control of a country like Japan, which, in spite of the veneer of twentieth centu industrialization presented to the casual observer, steeped in a tradition wholly alien to the outlook Western Europe and North America, withou adequate consideration of these factors.

So much for one specific problem posed by th control of Japan. The distance separating th country from Western centres will present difficulti for the maintenance of even a token occupatio force, both as regards supplies and the morale of th men; and numerous other points for anxious decisio must arise.

Many such matters must be regarded as involvin what has been termed the tactics of science. W must now revert to the broader question of th grand strategy of scientific and technical developmen The controlled release of atomic energy applied i the development of the atomic bomb emphasizes onc more the importance of scientific research, and i significance for the progress of knowledge and for th material welfare of mankind. Scientific and technica research has made possible this appalling weapon o destruction, and it will not let the matter rest ther As was pointed out in *Nature* of August 11, the discovery is the culmination of many years of patien and sometimes dangerous investigations, and the fac that it has been developed for the purpose of war i no fault or desire of scientific men as a body. They will therefore wish to push on vigorously with investigations of the mechanism of the reaction involved, and with their adaptation to the peace-tim needs of man. This may mean many years of labou —perhaps as many as have passed since the idea o atomic disintegration became more than the philosopher's dream. But they will not be deterred.

Nevertheless, means must be found of financing such investigations, which from their very nature can claim the interest only of those concerned with long-range developments; and present indications are that much elaborate and costly equipment on an engineering scale will be necessary. Only Governments or national institutions are likely to be in a position to respond to the requirements of research of this character in atomic physics. All this points towards the same conclusion as was reached in considering the moral aspects of the discovery of the regulated release of atomic energy, namely, it is a responsibility of Governments. The possibilities for good or evil are of such magnitude that individuals cannot fairly be entrusted with their exploration; similarly, none but Governments are likely to be able to provide the continuous expenditure necessary for development. Moreover, there must not be parsimony in the matter, as so often occurs when results do not immediately accrue; there must be faith in the outcome even when times are difficult and retrenchment seems inevitable. President Truman's request to Congress for provision for such research, and the British Government's announcement of its desire for collaboration, are therefore welcome moves; the Canadian Government is also to push on with investigations. The keynote in this matter, as in other affairs, is research, and yet more research. Research can be speeded up in time of national emergency, as we have recently seen, and now it is a matter of world emergency. Coupled with research there must be education, in the broadest sense, as has often been emphasized in these columns, so that nations may appreciate their responsibilities to their neighbours, who are now all the peoples of the world.

But we would conclude on a note of hope for the future. The end of the war with Japan marks the total defeat of aggression in the East and the West. To achieve it the freedom-loving nations have combined their forces, and incidentally voluntarily surrendered much of their freedom as sovereign States, while individual men and women have submitted to government largely by order from higher authority. It is not desirable or possible that such loss of democratic rights and privileges should continue; but it should be quite clear that the active association of the Great Powers must go on, in order that the world may recover from the disaster which has overtaken it. The United Nations Charter is a first step in this direction, on which it must be hoped that the nations of the world will build a structure enabling mankind to go forward in peace and prosperity to a new world order.

JOHN TYNDALL

Life and Work of John Tyndall

By A. S. Eve and C. H. Creasey. Pp. xxxii+404+25 plates. (London: Macmillan and Co., Ltd., 1945.) 21*s*. net.

JOHN TYNDALL was among the greatest masters of experimental demonstration that the world has seen. Davy, Faraday, Dewar and Bragg stood high in this category, and it is noteworthy that all these prepared and produced many of their demonstrations at the Royal Institution. In this particular direction Tyndall stood as high as any of them. It is not easy to realize how much of what is now the commonplace of lecture illustration in the physical sciences became so through him. He gave much thought and study to producing dramatic effects; indeed, stories were current which caricatured this aspect of his lectures, though it is difficult at this distance of time to judge whether any credence should be given to them. However that may be, there can be no doubt about the eagerness with which he was listened to, both in Great Britain and in the United States, nor about his great skill in carrying a popular audience with him.

The picture has, of course, another side. Some scientific men, among whom P. G. Tait was conspicuous, seem to have been much irritated by Tyndall's popular reputation, and hinted more clearly than good manners should have permitted that he verged on being a charlatan. I have looked over several of his books to try and judge for myself whether there was any real justification for this, but I cannot find that there was any.

Though I can remember Tyndall in the flesh, I was too young at the time to form any judgment of my own. The late Lord Rayleigh, however, who knew him well, thought highly of Tyndall's scientific work, and expressed himself more emphatically than was usual with him in the sense that Tyndall's critics were entirely mistaken in their estimate. He thought, however, that they had had their effect on Tyndall by putting him on the defensive.

The controversy about the doctrine of energy was one of the points on which Tait was most emphatic. It is not doubtful, I believe, that J. B. Mayer was the first to give a numerical value for the mechanical equivalent of heat, and that his value was substantially correct. If these facts are admitted (and I have not seen them denied), the plain man will not easily be convinced that Mayer's contribution was worthless. Yet Tait and also Kelvin were inclined to take this line. There was no doubt a serious flaw in Mayer's argument; but it may well be held that those who enunciate new and important results *which prove to be right in substance* should not be judged by the criteria which would be appropriate in marking an elementary examination paper a generation later. Tyndall, moved by a sense of justice, argued strongly in Mayer's favour, and I believe that the view which he took has been generally adopted in Germany; Helmholtz at least seems to favour it. Tait was probably right in assuming that Tyndall knew little of the more abstruse questions of mathematical physics: but it is not apparent that he ever professed to do so, and, after all, one cannot do everything. Tyndall, in spite of ill-health, and with no initial advantages, achieved a great deal for science in many directions. We should be grateful for what he was, rather than critical of what he was not. This book fills, at long last, a gap in the history of British science in general, and of the Royal Institution in particular.

The reviewer has read again, after an interval of more than fifty years, several of the essays contained in Tyndall's "Fragments of Science", and comes away with the impression that they have stood the test of time remarkably well. Phrases are occasionally met with which grate unpleasantly on the modern scientific ear, particularly where Tyndall deals with the electric arc, and the design of the dynamo; but if it is remembered that at the time the ampere and the volt had scarcely been defined, still less were any direct-reading instruments available for measuring currents and electromotive forces, this must in fairness be put down to the contemporary state of electrical science rather than to any shortcomings on the part of their author. By reading rather out-of-date accounts of scientific advances, one gets an insight into where the difficulty lay which is of great historical interest, and which fills a gap which can scarcely be filled otherwise. It is not at all easy for any student of scientific history to appreciate a difficulty which is no longer felt. In this matter of the efficiency of the dynamo, Tyndall's generation certainly felt at the back of their minds that there was some inherent obstacle to its working at a high efficiency. There is, of course, in fact no such obstacle, and it is very hard now to trace why they thought that there was. It is not suggested that Tyndall particularly countenanced this idea, though in some passages he seems to attach a theoretical importance to the internal resistance of the machine which reads oddly to-day.

It is difficult, coming to another aspect of Tyndall's writings, at this distance of time and in the intellectual atmosphere of the present day, to understand the storm which was aroused by his Belfast address to the British Association in 1874. A profound effect was provoked by that address, and the passage which was most resented has often been quoted—it runs thus: "The impregnable position of science may be described in a few words. We claim, and shall wrest from theology the entire domain of cosmological theory. . . ." The almost equivalent statement that "The Bible was not meant to teach science" might now be heard without surprise from any evangelical pulpit.

There can now be few, if any, survivors of those who hung on Tyndall's words at the Royal Institution and who would have been the most eager readers of this book. A series of unfortunate circumstances led to its late appearance. Chief among these, it must be confessed, was the very dilatory way in which Mrs. Tyndall dealt with the materials which were in her hands. In theory it had been her aim to devote her life to erecting this memorial to his memory, and as she survived him for many years, living a quiet life in the country, it would not seem at first sight that the opportunity to carry out this purpose was lacking; but misfortune seems to have dogged the project. Mrs. Tyndall began with an exaggerated notion of the scale on which such a book should be written. She was not prepared to reject anything; and under these conditions the amount of material proved unmanageable. Further, when it became obvious that she would never complete the work, she would not reconcile herself to putting the material in other hands, or to parting with the detailed control of how it was to be used. The result was that nothing effective was done while Mrs. Tyndall was alive. She provided, however, for its being accomplished by others, and her nephew, Mr. Granville Proby, has seen to the ultimate and satisfactory fulfilment of her wishes. He placed it in the hands of Prof. A. S. Eve, the biographer of Lord Rutherford, and when Eve was unable to continue, it was finally finished by Mr. C. H. Creasey.

As the result of this long delay, the book will not now be read by those whose personal memories would have illuminated the subject, but the story has at least been satisfactorily recorded for the present and future generations. RAYLEIGH.

BESSEL FUNCTIONS

A Treatise on the Theory of Bessel Functions

By Prof. G. N. Watson. Second edition. Pp. viii+804. (Cambridge: At the University Press, 1944.) 60*s*. net.

THE memoir in which Bessel, the astronomer, examined in detail the functions which now bear his name was published in 1824, and was the outcome of his earlier researches concerning the expression of the radius vector in planetary motion.

The ordinary linear differential equation of the second order

$$x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + (x^2 - \nu^2)\,y = 0 \quad . \quad . \quad (1)$$

is known as Bessel's equation of order ν. Any solution of this equation is a Bessel function of order ν. Neither x nor ν is necessarily restricted to real values.

If in (1) we write $u = y\sqrt{x}$, the corresponding equation for u becomes

$$\frac{d^2u}{dx^2} = -\left(1 + \frac{\frac{1}{4} - \nu^2}{x^2}\right)u$$

which for large values of x tends to the simple harmonic equation

$$\frac{d^2u}{dx^2} = -u, \quad . \quad . \quad . \quad . \quad (2)$$

the solution of which is well known to be of th form $u = A\cos x + B\sin x$, so that for large value of x, any Bessel function y may be expected t behave like $(A\cos x + B\sin x)/\sqrt{x}$. Moreover, jus as the general solution of (2) is expressed in term of the familiar special solutions $\cos x$ and $\sin x$, s the general solution of (1) is expressed in terms o any two linearly independent special solutions, fo example, the particular Bessel functions denoted b $J_\nu(x)$, $Y_\nu(x)$ where

$$\begin{aligned} J_\nu(x) &= \sum_{m=0}^{\infty} \frac{(-1)^m\,(\frac{1}{2}x)^{\nu+2m}}{m!\,\Gamma(\nu+m+1)} \\ Y_\nu(x) &= \frac{J_\nu(x)\cos\nu\pi - J_{-\nu}(x)}{\sin\nu\pi} \end{aligned} \quad . \quad . \quad . \quad . \quad (3$$

When ν is an integer n, $Y_n(x)$ is defined as the lim of $Y_\nu(x)$ when $\nu \to n$. These functions are know as Bessel functions of the first and second kind respectively. For large values of x they approac the respective values

$$\left(\frac{2}{\pi x}\right)^{\frac{1}{2}}\cos(x - \tfrac{1}{2}\nu\pi - \tfrac{1}{4}\pi),\ \left(\frac{2}{\pi x}\right)^{\frac{1}{2}}\sin(x - \tfrac{1}{2}\nu\pi - \tfrac{1}{4}\pi),\ (4$$

and this parallelism with the cosine and sine is on of the three reasons which the author adduces fo adopting $Y_\nu(x)$ as the canonical function of th second kind. Moreover, just as the solutions cos $\sin x$ of (2) are connected by $\cos x = \int \sin x\,dx$, s we have the relation

$$Y_\nu(x) = \frac{2}{\pi}J_\nu(x)\int\frac{dx}{xJ_\nu^2(x)}$$

between the functions (3), a suitable value of th constant of integration being presumed in each cas The forms (4) also show how to obtain approximat values for the large zeros of the functions (3).

The zeros of Bessel functions are important bot for the theory and for the physical applications Let $j_1, j_2, \ldots$ denote the positive zeros of $J_\nu(x)$ i ascending order of magnitude. Then

$$\int_0^1 xJ_\nu(xj_r)\,J_\nu(xj_s)\,dx = \tfrac{1}{2}J_{\nu+1}(j_r)\,J_{\nu+1}(j_s)\,\delta^{rs}$$

where $\delta^{rs} = 0$ or 1 according as $r \neq s$ or $r = s$ This leads to the Fourier-Bessel expansion of a function $f(x)$, provided such an expansion is possible in the form

$$f(x) = A_1J_\nu(xj_1) + A_2J_\nu(xj_2) + \ldots$$

where

$$\tfrac{1}{2}A_rJ^2_{\nu+1}(j_r) = \int_0^1 xf(x)J_\nu(xj_r)\,dx,$$

a method entirely analogous to that of Fourier's expansion.

Of great importance in mathematical physics are the modified Bessel functions $I_\nu(x)$ and $K_\nu(x)$ whic are certain particular solutions of the equation whic arises from (1) when ix is written for x. Here, fo example, if x is real and positive

$$I_\nu(x) = e^{-\frac{1}{2}\nu\pi i}J_\nu(ix).$$

Kelvin's functions ber x and bei x, which hav applications in alternating current theory, are th real and imaginary parts of $I_0(x\sqrt{i})$.

In applied mathematics Bessel functions find thei use in a wide field, of which a few instances can b ited in general terms: in hydrodynamics, to wave motions, vortices, viscous flow; in electricity, to microphones, transmission lines, skin currents, waveguides; in elasticity, to isotropic rods, torsional vibrations; in mechanics, to cylindrical rods, vibration of membranes, oscillating chains. Indeed it was in connexion with this last problem that Daniel Bernoulli in 1738 actually obtained an infinite series which is the expansion of a Bessel function, and noted that it had an infinite number of zeros.

One reason at least will make clear why numerous physical applications are to be expected. Laplace's equation in cylindrical co-ordinates (r,θ,z) assumes the form

$$\frac{\partial^2 V}{\partial r^2} + \frac{1}{r}\frac{\partial V}{\partial r} + \frac{1}{r^2}\frac{\partial^2 V}{\partial \theta^2} + \frac{\partial^2 V}{\partial z^2} = 0.$$

If we seek to satisfy this by $V = \mathrm{R}\Theta\mathrm{Z}$, where R, Θ, Z are respectively functions of r, θ, z alone, we find that $\Theta = e^{\pm i\nu\theta}$, $\mathrm{Z} = e^{\pm ikz}$, and if $u = kr$,

$$u^2 \frac{d^2\mathrm{R}}{du^2} + u\frac{d\mathrm{R}}{du} + (u^2 - \nu^2)\,\mathrm{R} = 0,$$

which is Bessel's equation. Thus, Bessel functions play the same part in potential problems relating to cylindrical boundaries (for example, the flow of heat) as do Legendre's functions in problems relating to spherical boundaries.

In Prof. Watson's treatise, which is a monument of erudition and of its often too rare accompaniment, clear exposition, we have a rigorous mathematical treatment of all types of Bessel functions, their properties, integral representations, asymptotic expansions, integrals containing them, allied functions, series, zeros, tabulation, together with extensive numerical tables. To quote from the preface to the first edition, "The book has been designed with two objects in view. The first is the development of applications of the fundamental processes of the theory of functions of complex variables. . . . The second object is the compilation of a collection of results which would be of value to the increasing number of Mathematicians and Physicists who encounter Bessel functions in the course of their researches. . . . While my endeavour has been to give an account of the theory of Bessel functions which a Pure Mathematician would regard as fairly complete, I have consequently also endeavoured to include all formulæ, whether general or special, which, although without theoretical interest, are likely to be required in practical applications; and such results are given, so far as possible, in a form appropriate for these purposes." This was written in 1922, and apart from a few minor corrections, the second edition is a photo-reprint of the first, the author stating that he was unprepared to undertake the rewriting of about half the book to the detriment of other activities. With this view we may sympathize, but at the same time we must regret that Prof. Watson has not taken the opportunity to include at least one new chapter on the application of Heaviside's operational calculus or its equivalent, the Laplace transform, to Bessel function theory, which has been so largely developed in the intervening twenty years. His unrivalled powers of exposition would have made this a welcome addition. Nevertheless, the book is one which nobody interested in Bessel functions can afford to ignore, or should even wish to do so.

L. M. MILNE-THOMSON.

FAMILY STUDIES IN TUBERCULOSIS CONTROL

Familial Susceptibility to Tuberculosis

Its Importance as a Public Health Problem. By Dr. Ruth Rice Puffer. (Harvard University Monographs in Medicine and Public Health, No. 5.) Pp. xi+106. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1944.) 2 dollars.

THE author of this excellent little book is a member of the Williamson County Tuberculosis Study, Tennessee; her object is to assess the significance of two factors in the development of tuberculosis: first, familial susceptibility; second, exposure to infection.

A review of past and present literature amply shows that many writers regard the susceptibility of the individual—the 'soil' as it is often called—as a factor equal in importance with infection in the causation of tuberculosis. At the same time it is generally agreed that if the infecting dose is heavy individual susceptibility is of much less importance. It is pleasant to read again the call that Karl Pearson made for sober reflexion, when, after Koch's discovery of the tubercle bacillus, popular opinion swung violently over to infection as the chief cause of tuberculosis with resulting complete neglect of all other factors. We shall do well to remember the need for clear thinking at the present time when so many new discoveries are being made.

The author goes on to show that many regard familial susceptibility as a factor in the development of several other diseases; but it seems unnecessary in a book of this size to devote nearly a whole chapter to discussing this in relation to leprosy, rheumatic fever, poliomyelitis, and diabetes. There is a useful account and discussion of animal experiments that show evidence of familial susceptibility; these are obviously of great importance. But it is surprising, in so wide a review of the literature, that mention is not made of immunization against tuberculosis with living attenuated bacilli (B.C.G.). Wells's experiments on immunizing animals with vole acid-fast bacilli also deserve mention, especially since there has been a recent revival of interest in attempts to immunize actively against tuberculosis (leading article, *Brit. Med. J.*, p. 716; December 14, 1943).

In discussing the analysis of the data presented, the author stresses the need for a suitable tuberculosis classification such as Opie's, which is used. This classification is given in detail as an appendix to the book. Frost's statistical method ("person—years of life experience") as applied to morbidity- and mortality-rates is most suitable in work of this kind. Full details of this method, which is an adaptation of life table procedures, are given in an appendix to the book. There are many advantages in using the 'index case' instead of the 'primary case', the 'index case' being that of the individual whose medical history of known or suspected tuberculosis directs attention to his family or associates. Data from the Williamson County Study that concern siblings, consorts, parents, and children of 'index cases' are analysed and discussed in comparison with similar studies by other workers. Interesting work on twins is discussed, and figures are quoted to show that tuberculosis-rates are higher in the co-twin of uniovular twins than of binovular twins. But it must be remembered that uniovular twins are of the same sex and are as a rule very closely associated.

An interesting explanation is given for the decline of the tuberculosis death-rate: when the rate is high more females die than males; but as the rate falls the sexes are equally affected, as in England about 1860; thereafter the male death-rate begins to exceed the female. This, it is said, is due to the deaths of females during the child-bearing period and the result is a reduction of the number of susceptible families. This point is well worth remembering when assessing the value of control measures over a number of years.

More light is thrown on the vexed question of tuberculosis in consorts. It is known that a large proportion of exposed consorts do in fact develop the disease, but that others remain well. The family history of exposed consorts shows that those whose families are tuberculous show a higher incidence of the disease than those whose families are free from tuberculosis. It is emphasized that to know the true picture for children they must be followed up after they leave the home.

In a concise summary the author outlines how better methods of control could be instituted by a more comprehensive case-finding campaign based on information about those persons known to have tuberculosis and about susceptible families. Surprisingly, mass miniature radiography is not discussed; it is by this method above all others that much wider groups can now be examined than ever before.

Although it offers nothing outstanding in the way of new discoveries, this book succeeds in its aim of throwing more light on the problems of susceptibility to tuberculosis, and it includes a really remarkable amount of useful information in just over a hundred pages. The volume is well written and presented, the graphs and tables are clear and easy to understand, and a full bibliography is included. All concerned in the control of tuberculosis—public health officers, tuberculosis officers, health visitors, social workers general practitioners, and medical research workers —should find much to interest them in its pages.

THE CHILD'S BLOOD IN HEALTH AND DISEASE

Atlas of the Blood in Children

By Dr. Kenneth D. Blackfan and Dr. Louis K. Diamond. Pp. xiv+320 (70 plates). (New York: Commonwealth Fund; London: Oxford University Press, 1944.) 66*s*. 6*d*. net.

ALTHOUGH we have long been accustomed to coloured illustrations in text-books and monographs on hæmatology, we find in this "Atlas of the Blood in Children" something above the ordinary not only in its extent, but also and more especially in the happy combination of faultless artistry and perfect colour-printing. The very slight variation in colouring due to the routine use of Wright's stain in place of those more commonly used in Great Britain, namely, Leishman or Giemsa, does not detract in the slightest from the value of the seventy plates used to illustrate the important features of the blood pictures of more than five thousand cases examined and catalogued by the authors in their special hæmatological laboratory in the Infants' and Children's Hospitals, Boston. A special point is made of the fact that the "Atlas" is not intended as an exhaustive treatise on the variations in the blood in diseases of children, but represents only conditions with whic the authors have had close personal experienc This will explain some omissions, and also the appa ently undue stress laid on diseases seldom seen i Britain, such as Meditteranean anæmia and sickle ce anæmia.

The text deals with the hæmatology of childhoo in five main sections: the blood cells; anæmias; th leucocytes in disease; the leukæmias; the platelets The first section has much valuable information, bu will be spoilt for most British readers by its use o the term 'megaloblast' for the parent cell in th normal development of the red blood corpuscles Once the necessary mental adjustment has been mad to allow for this divergence from hæmatologica nomenclature in Britain, the rest of this, and of the succeeding section on the erythrocytes in anæmia, can be read with real pleasure and much profit. The authors have adopted a purely morphologica basis for the classification of the anæmias, which, though somewhat outdated, lends itself admirably to a treatise in which pictorial representation of the blood as seen in stained films is the *raison d'être* of the publication. The inclusion of a separate group of "Anaemias often associated with Jaundice", though inconsistent with this classification, has its points clinically.

The section on "The Leucocytes in Disease" has much valuable observation condensed in the few pages devoted to it. Particularly valuable are the full descriptions of significant blood pictures in pulmonary tuberculosis and infectious mononucleosis. In the section on leukæmia there is perhaps an over-elaboration of clinical types and too facile a dismissal of the value of marrow puncture. The last section, on the platelets, is adequate, but contains an inexplicable confusion between Henoch's and Schönlein's purpura. This lapse will certainly cause the authors no heart-burnings, since they rightly dismiss these subdivisions of purpura as of little real significance.

The "Atlas" and its text are obviously intended primarily for the practising pediatrician and his hæmatologist. Full case histories of selected illustrative examples of the various disease states are included but are not overdone. Commendable restraint is also exercised in the details of laboratory data, particularly in the matter of descriptions of the blood picture presented, the very realistic coloured plates of blood films taking the place of these descriptions. There is little attempt at discussion of debatable theories and hypotheses, and if this does at times result in the apparently uncritical acceptance of views still *sub judice*, it certainly leads to brevity. There is a healthy insistence on the practical in both treatment and investigation, and the dangers and advantages of blood transfusions receive frequent and carefully considered mention. The sequence of the illustrations follows that of the text, and each plate is faced by an outline drawing on which the characteristic or abnormal cells are numbered for detailed reference in the descriptive legends. The printing is excellent, the style easy and the indexing satisfying.

This joint production by the clinician, the laboratory hæmatologist and the artist is one which goes a long way towards filling a serious gap in the bookshelves of pediatricians and clinical pathologists, and can be warmly commended not only to these but also to all who have any contact with hæmatology in general or with children in any branch of medical practice. THOS. B. DAVIE.

A HITHERTO UNPUBLISHED LETTER OF ISAAC NEWTON

HE Royal Society recently received, on indefinite loan from its present owner, a hitherto unrecorded tograph letter of Isaac Newton. The letter is a ıg one, it has an intrinsic interest for the history science, it is in a remarkably good state of preserva- n and its authenticity is established with unusual mpleteness. It was written in 1677 from Cambridge the Hon. and Rev. Dr. John North, then living London, but later Master of Trinity College, Camidge. The present owner of the letter, Mr. Roger orth, of Rougham, King's Lynn, Norfolk, who has aced it in the custody of the Royal Society, makes e very probable suggestion that the "new Treatise Musick", with which the letter deals, was "A ilosophical Essay on Music", by Francis North, ord Guilford, to whose brother the letter is ldressed.

The letter is written on both sides of a sheet of per measuring about 15½ in. by 12 in., in a very at and easily legible hand, which is certainly that Newton. One half of one side was left blank, so at on folding for postage it could be addressed ithout envelope. On one of the blank oblongs left y this folding, the letter has been further identified y endorsements written by (1) Roger North, son the Hon. Roger North of Rougham and nephew Dr. John North, the recipient; and (2) Frederick orth, great-grandson of (1) and great-grandfather the present owner, Mr. Roger North of Rougham. he fine state of preservation is explained by the ct that, as Mr. North informs me, the letter had een kept continuously between the leaves of a folio olume in the family library, until he recently had framed between plates of glass.

The scientific world is indebted to Mr. North's enerous thought, which has now made the letter vailable for study by placing it in the Royal Society's ibrary. The publication of the following text of the locument will, meanwhile, make its substance available to the readers of *Nature*.

H. H. DALE.

Cambridge Apr 21.1677

Sr

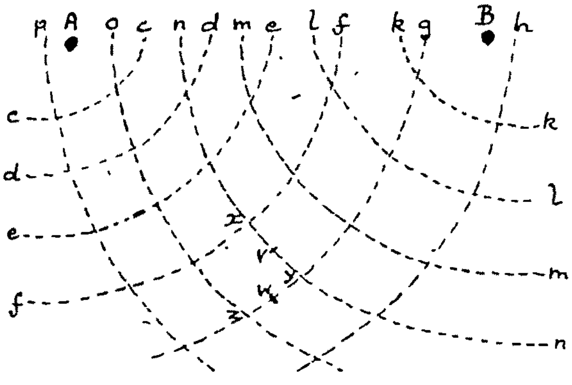
The esteem you express of my judgment I must impute to yo^r goodness who are willing to make y^e best of every thing. Yet since it is yo^r desire to have my opinion about this new Treatise of Musick, I shall give it you, though perhaps not so largely as you may expect, there being some things which I cannot speak positively to for want of experiments & skill in Musick.

Pag 5 lin 14 & pag 6 lin 30, the Author asserts y^t sound is produced in y^e Torricellian vacuum, & thence seems to collect y^t y^e medium of sound is not y^e grosser Air but some subtiler aerial fluid of a middle nature between y^t Air & AEther, wch can penetrate glass & other gross bodies. But it is to be suspected y^t this experim^t of y^e Torricellian Vacuū holds only when y^e glas is not well emptied of Air. For M^r Boyle (Exp^t 27) repeating it wth a watch hung in his Receiver, found that as y^e receiver was more & more emptied, y^e noise made by y^e Ballance wheel grew fainter & fainter till at last it was not heard at all though y^e handle & wheels of y^e watch were still seen to continue their motion as freely as at first. Yet y^e louder sound of a Bell continued audible when y^e air was drawn out, though perhaps it would not have done so could y^e Receiver have been fully exhausted of Air, & y^e Bell have been susteined in y^e Receiver by something w^{ch} might not touch y^e glas. To y^e best of my remembrance I have also some where read of an Alarm Watch whose Alarm being made to go, y^e sound of y^e Bell grew faint by drawing out y^e air.

Pag 5 lin 18 The Author asserts y^t a sound seems to come in streight lines to y^e ear though an obstacle be situated between y^e ear & y^e sounding body so y^t it cannot come in streight lines. But this I doubt of if, he mean y^t it seems to come in streight lines from y^e sounding body. If indeed y^e interposed obstacle be not too gross & compact, suppose a glass window or thin wall of wood or mortar, y^e air may by shaking it propagate y^e sound through it, & then y^e sound will be heard in a streight line from y^e sounding body: but if y^e obstacle be massy, suppose a very steep & high hill or a solid high wall of brick or stone, I am apt to think y^e sound will seem to come from y^e top of y^e Hill or Wall rather then in a direct line from y^e sounding body behind it. And some such diverting of sounds I have observed occasionally, in walking on a street close by a single House whilst bells were ringing on y^e other side. The house to y^e best of my remembrance had no windows on that side next me & y^e sound of y^e bells seemed to come from y^t end of y^e house w^{ch} I was nearest to, though y^e bells were directly behind it so in a Room of stone walls wth but one window, the sound will seem to come from y^e window though y^e sounding body without lye not that way.

Pag 8 lin 14 The Author affirms y^t where y^e vibrations of two sounding strings are equal, they will work one another to a coincidence or synchronism, & on this position grounds all his discours of concords & discords, affirming y^t unisons alway strike y^e ear together, Octaves at every other puls of y^e Treble, fifts at every 3^d pulse &c. But it seems otherwise to me for though y^e pulses of y^e strings should reduce one another to a synchronism, yet those of one string will strike y^e ear sooner or later then those of y^e other, accordingly as y^e ear is more or less near to one string then to y^e other.

Since sounds are not propagated in a moment, y^e pulses must not be supposed to extend each of them at once from y^e sounding body to y^e ear in such manner y^t all y^e air in that interval be moved together first forward & then backward, & so forward & backward again so long as y^e sound lasts: but y^e pulses are rather to be conceived like so many spherical concentrick waves whose center is y^e sounding body & w^{ch} arising continually from y^t center dilate & flow on from thence with that swiftness we find sound propagated till they arrive at y^e ear; new pulses from y^e center continually succeeding them after y^e manner of undulations made by throwing a stone into water. Let therefore A & B represent two sounding bodies of like tones, c,d,e,f, &c y^e pulses continually propagated from A; & k,l,m,n, &c y^e pulses propagated from B. And if y^e ear be placed at x, or y, or z, or any place where y^e pulses at any time intersect, they will strike y^e ear at y^e same time, but if it be placed between x, & y suppose at v, y^e puls xn w^{ch} comes from y^e Body B will strike it in y^e intervall of y^e pulses xf & yg w^{ch} come from y^e body A. And the like will happen if



y^e ear be placed between y & z as at w, or in any pulse of one body & between two pulses of y^e other. So that y^e ears of two men or y^e two ears of y^e same man according to their position from y^e sounding bodies may be struck the one at once y^e other successively by y^e pulses, & yet in all positions of y^e ear y^e sounds & their harmony are heard y^e same. The like of bodies tuned to a fift or any other Concord. Seing therefore y^e pulses of two sounds may at y^e same time strike one ear both together & another ear alternately & yet do exhibit y^e same concord to all ears, it follows 1st that concords arise not from y^e coincidence of pulses at y^e ear nor have any dependance on such coincidences, & 2^{dly} that unisons are rather a harmony of two like tones then a single tone made more loud and full by y^e addition as y^e author would have it, p.8.1.20.

The explication of y^e sound of whistles pag 12 is very ingenious, but I fear not altogether substantial. Yet for want of apposite experiments I can neither sufficiently confute it nor confirm any new Hypothesis.

The discours also about breaking of Tones into higher notes seems very ingenious & judicious, but I want experience to discern whether altogether solid, & much more do I want experience & skill to enable me sufficiently to judge of what follows about Tunes, y^e scale of Music, & consort; this requiring a combination of musical & mathematical skill, & therefore I shal content my self wth having thus far animadverted upon y^e Author.

I am much obliged to you for giving me notice of the objection made against my notion about colours. But y^e experiment succeeds otherwise then tis reported. If you place your eye where y^e blew light falls on y^e wall so y^t a by-stander see your eye of a blew colour you will at y^e same time see y^e Prism of a blew colour; and so if you place you eye in y^e red light you will see y^e Prism red. What colour a By-stander sees fall on yo^r eye you will see at y^e Prism: as I can affirm by iterated experience.

The last week I called at yo^r Lodgings & hope ere long to have an opportunity to wait on you again. In y^e meane time I rest wth my thanks to you for yo^r kind acceptance of my former Letters

Yo^r humble Servant
& honourer
Is. Newton

For the Rnd & Hon^{ble}
Dr North, to be left
at Mr Pawley's at
the Bible in
Chancery Lane
London

ENZYME ACTIVITY AS A FACTO IN INSECT PHYSIOLOGY AND TOXICOLOGY

By Dr. H. HURST
Department of Colloid Science, Cambridge

FOR many years the search for new insecticides ha proceeded on the working hypothesis tha toxicity is related to highly specific molecular configurations in the insecticide molecules. An excellen example of the analytical approach used by th chemist has been provided recently by Lauge Martin, and Müller, who have made an exhaustiv and critical examination of the constitution and toxi action of natural insecticides, such as pyrethrins an rotenone, and in particular, the new synthet insecticide D.D.T. (α,α-bis-(4-chlorphenyl)-β,β,β-tr chloroethane)[1]. But before any evaluation of insecticidal activity may be made in terms of specific grou concepts, it is necessary to take into account som less specific dynamic factors in activity. In thi connexion, the carrier medium in which an insecticid is dissolved may alter the permeability of the insec cuticle and so modify access of insecticide to th internal tissues[2].

The importance of this rate factor in access o insecticide becomes apparent if we make the vali assumption that insecticidal activity is associated with some disturbance in the chain of consecutiv vital processes which regulate the dynamic balanc in internal tissue metabolism. If gross biological responses, such as paralysis or death, can be identified more specifically with changes in enzyme activity, a step forward will have been taken towards the elucidation of the more interesting anomalous systems in insect toxicology where there is no apparent coincidence between molecular structure and insecticidal activity.

These concepts will be illustrated in the present article, where an attempt is made to define the biophysical factors which influence the uptake of insecticide by the insect cuticle and internal tissue receptors. Some new factors in insecticidal activity will be described, depending on the discovery that phenoloxidase activity in the cuticle and sensitive tissue receptors* may be greatly modified by the selective environmental influence of the structural components associated with the enzymes *in vivo*. Narcosis, or knock-down action, may involve the indirect blocking of enzyme activity by the adsorption of insecticide on the protective lipo-protein tissue components. Lethality usually involves an irreversible increase in phenoloxidase activity owing to the displacement of protective lipoid from the tissue receptor complex. This stage is accompanied by the accumulation of toxic quinonoid metabolites in the blood and tissues, and is characteristic of the lethal action of insecticides and simpler fat-soluble drugs. Relative susceptibility of insects to contact insecticides depends partly on cuticle permeability, but more fundamentally on the stability of the internal tissue receptors which regulate the internal balance in oxidative metabolism.

Apart from differences in molecular structure, insecticides as a class are fat-soluble. The access of contact insecticides involves the uptake and storage of insecticide by the outer lipophilic epicuticle layer of the insect cuticle. In blowfly larvæ, such as *Calliphora erythrocephala*, or *Phormia terrænovæ*, the soft cuticle is hydrophilic, and the receptor surface of the epicuticle is heterogeneous, consisting of a mosaic arrangement of lipoid and protein receptor patches[3]. Even where the cuticle is waxy, as in *Tenebrio molitor* larvæ, the presence of protein receptors in the epicuticle may be demonstrated by means of protein anning reagents. Pryor[1] has stressed the analogy between the natural tanning of insect cuticle and the tanning of gelatine by *p*-benzoquinone, but whereas the tanning of insect cuticle by *p*-benzoquinone takes place more rapidly in organic fat solvents than in aqueous substrates, this selective carrier activity is not shown with lipoid-free proteins such as gelatine. Fat solvents which increase the permeability of the cuticle to water-insoluble insecticides, such as pyrethrins or D.D.T., also increase the rate of access of *p*-benzoquinone, so that a given concentration of the reactant is more active in an oil than in an aqueous carrier medium[3].

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* The term 'receptors' is frequently used in pharmacology to indicate the sites of action in biological systems with which drugs are supposed to combine or exert specific actions.

Here we have a clue to the nature of the spatial changes induced in the epicuticle receptors by the fat-solvent carriers, for these changes must increase the permeability of the cuticle both to fat-soluble and to water-soluble drugs. Similarly, the sensitization of the cuticle by fat solvents is associated with an increase in the permeability of the cuticle to water, suggesting a displacement of protective lipoid from the more hydrated receptors[2,5]. Morphologically, the epicuticle receptor system must be consistent with toxicological and physiological behaviour. The lamellar structure of insect cuticle suggests that the plane of orientation of the epicuticle lipo-protein micelles is parallel to the cuticle surface. This is further supported by the X-ray diffraction studies of Fraenkel and Rudall on the chitin-protein crystallites of the bulk cuticle framework[6]. Chargaff has shown that the association of a lipoid, such as cephalin, with basic proteins, such as histone or protamine, results in the formation of relatively stable lipo-protein complexes owing to the interaction of the negative groups of the cephalin with the positive groups of the protein[7]. This complex-formation is accompanied by the expulsion of water from the hydrated protein. Since the tanning of the cuticle by *p*-benzoquinone probably involves the interaction of the quinone monomer with the $-NH_2$ groups of the protein side-chains in the lamellar cuticle fabric, it is likely that fat-solvent sensitization of the epicuticle involves the spatial displacement of lipoid, possibly of the cephalin type, which is normally attached to the basic side-chains of the protein receptors

The physiological requirements of the cuticle as a membrane impermeable to water would be satisfied by the intercalation of labile lipoid between the protein-rich structural lamellæ of the epicuticle framework. But the association of a fat-solvent with such a simplified lamellar fabric would not induce rapid access of water-soluble or oil-soluble drugs, owing to the discontinuous nature of the lamellar receptors across the cuticle framework. However, a microscopic mosaic network of lipophilic and more hydrophilic receptor patches can be detected in the epicuticle of *Musca domestica* larvæ which have been artificially tanned with *p*-benzoquinone. The interaction of the monomer with the protein receptors is accompanied by its oxidation and polymerization *in situ*. In this way a further degree of rigidity and stability is conferred on the epicuticle framework and inner cuticle layers. The brown polymerized oxidation products of the quinone do not become uniformly distributed throughout the epicuticle, but form a mosaic of dark tanned patches enclosed within a more continuous refractile network. These discrete receptor loci are approximately 2–2·5 μ in width when seen in optical section and extend radially across the epicuticle framework to a depth of about 3 μ. When the cuticle is sensitized with a fat-solvent, the mosaic tanned network becomes more diffuse; but tanning takes place most rapidly in the discrete patches within the refractile network, showing that protective lipoid is selectively displaced from these receptor zones. After prolonged contact with fat-solvents, the labile lipoid becomes eluted from the epicuticle framework, and even the refractile regions are tanned rapidly by *p*-benzoquinone.

By combining such a mosaic receptor system with a lamellar epicuticle framework, the access of drugs becomes consistent with the physiological role of the epicuticle as a protective water-impermeable barrier, which conserves essential water in the living insect. The primary uptake of fat-solvent by the lipoid-rich mosaic receptor network increases the continuity and permeability of this phase across the epicuticle. At the same time, the immobilization and storage of fat-solvent within these loci dissolves or displaces the adjacent inter-lamellar lipoid, which accumulates in the transverse lipophilic network and increases the relative phase volume of this system. There is thus an increase in the continuity and permeability of both the lipoidal and protein-receptor components of the mosaic across the cuticle framework.

The natural hardening or tanning of insect cuticle is an enzymic process, and Dennell has provided interesting evidence to show that the localization of a phenoloxidase and polyphenol in the epicuticle of *Sarcophaga falculata* larvæ may partly explain the more rapid hardening of the outer cuticle layers[8]. According to Dennell, the polyphenol substrate of the cuticle is an oxidation product of tyrosine, which is oxidized in the blood by the enzyme tyrosinase and diffuses into the outer layers of the cuticle. The isolated cuticle of *Musca* larvæ and other insects darkens in the presence of tyrosine or catechol substrates, but hardening does not take place in the tyrosine substrate. On the other hand, a tanning process, which is analogous with the natural changes *in vivo*, occurs in catechol substrates; but the action differs from the tanning in *p*-benzoquinone substrates in that the reactive *o*-quinone is formed enzymically within the cuticle framework after access of catechol has taken place.

The natural tanning of insect cuticle, however, does not simply involve the combination of the natural polyphenol substrate with molecular oxygen in the presence of polyphenol oxidase. The addition of hydrogen peroxide to an aqueous catechol substrate greatly increases the rate of tanning of the cuticle even when the enzyme receptors have been exposed by fat-solvent sensitization. This reaction is thermolabile, and is due to the presence of a highly active polyphenol peroxidase which is secreted into the cuticle by specialized epidermal cells. Enzymic tanning may be accelerated by the presence of fat-solvents in the cuticle framework similarly to the induced tanning by *p*-benzoquinone, and this suggests that the labile protective lipoid is attached to the enzyme prosthetic groups. That the polyphenol peroxidase is associated with the protein structural components of the epicuticle mosaic is shown by the coincidence in the mosaic pattern which develops in

p-benzoquinone and in catechol substrates, but this pattern is still further intensified in the presence of hydrogen peroxide. The natural polyphenol substrate is secreted by epidermal cells into the epicuticle by means of a network of ducts which open by discrete pores on the surface of the epicuticle. The selective concentration of polyphenol in these zones produces local darkening of the cuticle in ammoniacal silver nitrate solution. The cuticle peroxidase is similar in many respects to the peroxidase in horseradish roots[9]. Catechol is rapidly oxidized by an aqueous horseradish root extract in the presence of hydrogen peroxide. The natural hardening of insect cuticle can be accelerated by abrading the outer cuticle surface and treating the abraded areas with a concentrated aqueous horseradish extract.

The cuticle peroxidase appears to play an important part in the determination of macroscopic cuticle pattern. In *Musca* larvæ and in related blowfly larvæ, the whole cuticle becomes uniformly tanned after sensitization with a fat-solvent and immersion in an aqueous substrate containing catechol and hydrogen peroxide. This is analogous to the formation of the puparium *in vivo*; but in other insects, such as *Tenebrio molitor* larvæ, a segmental cuticle pattern may be developed in a similar manner to the appearance of an image on a photographic plate by this treatment.

These examples of cuticle sensitization have been selected to show how the association of a simple fat-solvent with the cuticle receptors may initiate a complex chain of interdependent biological changes. The physical nature of the primary stimulus is shown by the fact that cuticle sensitization may be brought about by rubbing the cuticle with adsorbent powders, such as silica, charcoal, or alumina. These powders, which also act as 'inert' insecticidal dusts, not only increase the permeability of cuticle by local 'abrasion' of superficial epicuticular lipoid, as Wigglesworth has shown[10], but also induce a more uniform displacement of internal protective lipoid by adsorbing superficial lipoid from the outer layers which communicate with the internal mosaic receptor network[3]. The coincidence between the segmental tanned cuticle patterns which develop when *Tenebrio* larvæ are sensitized by fat-solvents and by the action of adsorbent powders indicates that both treatments expose the more internal peroxidase receptors to access by catechol.

In these systems there is a competition between the protective lipoid and the substrate catechol for the cuticle peroxidase receptors. But a still more complex competition is shown between two enzymes in the cuticle framework for the same component in the substrate. Peroxidase activity is inhibited by the enzyme catalase, which decomposes hydrogen peroxide into water and molecular oxygen, and so prevents the accumulation of toxic concentrations of hydrogen peroxide in the tissues. The outer epicuticle is permeable to peroxidase, but not to catalase, and the progressive hardening of the cuticle from the outside inwards which takes place *in vivo* and in catechol substrates containing hydrogen peroxide is due to the gradient of peroxidase inhibition produced by the selective localization of catalase within the cuticle framework. Similarly, selective access of catalase to the thinner intersegmental regions of the cuticle in *Tenebrio* larvæ inhibits peroxidase activity, and so the flexibility of the cuticle in these regions is maintained during the hardening of the cuticle. Here is a very interesting example of how physiological function in a protective membrane may be influenced by the selective competition of enzymes within the membrane fabric. This selective segmental tanning is not shown in p-benzoquinone substrates. In these systems, tanning of the cuticle depends on the general availability of protein receptors within the membrane, and tanning takes place at the intersegmental membranes.

If, by analogy with the cuticle receptor system, we assume that the toxicity of insecticides at the internal tissue receptors depends on the disturbance of the dynamic physiological balance in oxidative tissue metabolism, it becomes possible to obtain some insight into the way in which insecticides and simpler drugs of different molecular structure exert similar pharmacological actions. For example, the cuticle and tissue phenoloxidases are relatively diffusible*, and the relation between tissue peroxidase activity and the drug concentration of the hæmolymph may be studied by removing some of the cuticle from the body wall of mature *Musca domestica* larvæ and immersing the insects in standard volumes of phosphate buffer (pH 7·4) containing fixed concentrations of catechol (0·5 per cent) and hydrogen peroxide (5 per cent of 10 vol. solution), and variable concentrations of a simple narcotic, such as ethyl alcohol. The rate of enzymic oxidation of the catechol may be measured by the reddening of the tissues and substrate. Typical results show that with increase in the alcohol concentration of the substrate (0–6 per cent) there is a progressive decrease in peroxidase activity accompanied by the inception of narcosis in the insect. With further increase in alcohol concentration (6–25 per cent) there is no marked change in peroxidase activity; within this range drug tolerance is shown by the persistence of narcosis. This reduction in peroxidase activity cannot be due to direct combination of the alcohol with the enzyme, for with higher concentrations of alcohol (25–60 per cent), peroxidase activity rises to a maximum value higher than that in the control system in which alcohol is absent. With still further increase in alcohol concentration, peroxidase activity decreases owing to tissue denaturation. These selective changes in peroxidase activity are not shown by aqueous extracts of tissue where the enzyme is no longer associated with the structural tissue organization.

From this unusual relationship between the drug concentration in the substrate and tissue peroxidase activity, it may be inferred that the competition between a drug and a specific substrate for an enzyme does not necessarily take place according to the mass action law which generally holds in liquid non-structural systems containing isolated enzyme preparations. The selective environmental influence of a tissue component sensitive to a narcotic is shown by the parallelism between the changes in catechol peroxidase, catechol oxidase, and tyrosinase activity which takes place in the appropriate systems with change in the concentration of alcohol in the substrate†. Moreover, the rate of change of phenoloxidase activity with concentration of drug varies with different insects. For example, hæmolymph concentrations of ethyl alcohol, which decrease tissue phenoloxidase activity in *Musca* larvæ and induce narcosis, may increase phenoloxidase activity in *Tenebrio* larvæ. Within critical ranges this increase is lethal and results in the darkening of the blood owing to an increase in tyrosinase activity. Here the substrate is tyrosine, which is a product of tissue metabolism. The intermediary stages in the tyrosinase-tyrosine reaction have been elucidated by the classical work of Raper[11]. It is clear that, in addition to a factor of cuticle permeability, the relative susceptibility of insects to the same insecticide will depend more fundamentally on an internal environmental factor associated with the stability of the tissue receptors.

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* This diffusion of enzymes, which are of high molecular weight, is brought about mainly by convection transport in the hæmolymph and by the movements of the living insect.

† The increase in catechol oxidase activity in the presence of lethal alcohol substrate concentrations may also be demonstrated using manometric methods, which show the correlation between the reddening of the substrate and the oxygen uptake. Similarly, colour formation and oxygen uptake are decreased by inhibitors such as hexyl resorcinol.

The components sensitive to a narcotic must be such that the affinity of monohydric alcohols for these structural receptors is greater than the affinity of the drugs for the phenoloxidase systems. The nature of these accessory receptors is shown when a comparison is made between the narcotic actions of the lower members of the homologous series of monohydric alcohols. In *Musca* larvæ, the exponential rate of decrease in the threshold concentrations of narcotic in the substrate or drug in the hæmolymph as the series is ascended from methyl to amyl alcohol forms a Traube series characteristic of drug distribution between immiscible oil/water phases. Similar results have been described for related blowfly larvæ[2]. From this evidence it would seem that the narcotic sensitive tissue receptors are lipoidal, or more probably lipo-protein in nature. The increase in phenoloxidase activity at lethal concentrations of drug suggests that the permeability of the tissue receptors to drug and essential substrate molecules is increased by the displacement of protective lipoid from the protein-enzyme tissue complex. But apart from this permeability factor, depending on lipoid solubility, the lipoid receptors also influence the steric approach of the drug to the enzyme receptors, for with the capillary-active alcohols reduction in tissue phenoloxidase activity takes place only within the range of biological drug concentrations where the displacement of protective lipoid is reversible. At higher lethal drug concentrations, this selective steric factor is no longer dominant owing to the dispersion of protective lipoid from the enzyme. In a similar way, access of substrate catechol is influenced by the non-polar association of the benzene nucleus of the catechol molecule with the lipoid receptors, and by the more specific two-point polar attachment of the hydroxyl groups of the catechol with the prosthetic groups of the enzyme.

One important result which emerges from these biological complexities is that narcosis and lethality are only indirectly related to changes in aerobic phenoloxidase activity, owing to the selective environmental influence of the tissue receptors sensitive to a narcotic. But it is known that the tissue or cell dehydrogenases are also inhibited by narcotics or depressants, and in order to gain an insight into the nature of drug specificity it is necessary to study the action of these drugs on the aerobic and on the anaerobic components of respiratory systems. Dehydrogenase activity is usually studied by determining the rate of reduction of an autoxidizable dye, such as methylene blue, in the presence of tissue, substrate, and drug, under anaerobic conditions. When methylene blue is injected into the hæmolymph of insects, the dye is taken up by the tissues, and is partly or completely reduced, depending on the concentration of dye present, and on the oxidation-reduction potential of the substrate. If drugs are now applied externally to the insect cuticle, the change in the colour of the dye, which may be observed through the cuticle, gives an indication of the relative changes in dehydrogenase activity. At the same time, the darkening of the blood and tissues provides a measure of the changes in aerobic tyrosinase activity. In this way the dynamic changes in aerobic and anaerobic oxidative processes may be compared under conditions in which insecticides are usually applied to insects *in vivo*. Suitable test insects are *Tenebrio molitor* larvæ, or mature *Musca domestica* larvæ. Some significant conclusions emerge when a comparison is made between the action of simple non-polar and polar or capillary-active drugs. These may be summarized briefly as follows.

(1) Both the aerobic and anaerobic enzymic oxidative processes are influenced by the tissue receptors sensitive to a narcotic.

(2) The transition from narcosis to death induced by the action of non-polar fat-solvents such as hexane, *cyclo*hexane, benzene, or chloroform is accompanied by an increase in tissue phenoloxidase activity and tissue dehydrogenase activity, suggesting a sensitization of the structural lipo-protein tissue receptors which is analogous to that induced in the mosaic lipo-protein receptor organization of the insect cuticle.

(3) Increase in the hæmolymph concentration of primary monohydric alcohols produces a similar sensitization of the tissues as non-polar fat-solvents, but with the lower members (methyl → propyl alcohol) the increase in tissue tyrosinase at lethal concentrations in the hæmolymph is accompanied by an inhibition in dehydrogenase activity, suggesting a more specific susceptibility of these systems to the alcohol hydroxyl group. The competition between the lipoid tissue receptors and the dehydrogenase receptors for the drugs is shown by the fact that, as the drug series is ascended from propyl to butyl alcohol, the inhibition of dehydrogenase activity falls off sharply, and with higher homologues the fat-solvent properties of the molecules are dominant factors in activity.

(4) With the related homologous series of monocarboxylic acids the relatively strong polar interaction of the carboxyl groups with the protein-enzyme receptor complex is dominant, and both phenoloxidase and dehydrogenase activity are inhibited by low concentrations of drug in the hæmolymph.

(5) The narcotic and lethal actions of non-polar fat-solvents and inert fat-soluble drugs, such as primary alcohols, are probably associated mainly with changes in aerobic oxidative enzyme activity. The phenoloxidase systems in *Tenebrio* larvæ are much more sensitive to drug-dispersant action than in *Musca* larvæ, where the insects are much more resistant to the narcotic action of fat-solvents in general. On the other hand, the tissue dehydrogenase systems show similar degrees of susceptibility in both species of insect.

These principles appear to be of general application in wider fields of pharmacology and suggest that the discrepancies which have hitherto existed between the simple principles of Overton-Meyer, Traube and the somewhat static specific group concepts of Ehrlich are fundamentally biological. The changes in enzyme activity, which are dependent on changes in the selective environmental influence of the lipo-protein tissue receptors, suggest the interesting possibility that the cytochrome system, which is probably the most important component of the respiratory system in insects and other organisms[12], is similarly influenced, and it is hoped to investigate this aspect by the use of spectroscopic techniques.

When we come to examine more complex insecticidal systems, it is clear that similarity in biological response may merely indicate a coincidence in the dynamic chain of metabolic changes initiated at different links in the chain. For example, pyrethrins I and II are complex unsaturated ketonic esters which differ completely in molecular structure from the relatively simple inert fat-soluble D.D.T.[1]. Yet similarity in insecticidal action is shown by a dispersant action on the cuticle and internal tissue lipoids, and the lethal stages of poisoning reveal an increase in the phenoloxidase activity of tissue and hæmolymph. The minute nature of the lethal dosages is consistent with an adsorption process on the tissue receptors; but it is unlikely that narcosis or death is directly related to primary insecticide-tissue combination. A contributory factor may be the accumulation of reactive *o*-quinones which would block essential substrate access to the whole complex of enzyme systems normally associated with the tissue components. This narcotic stage would be followed by death when the further dispersant action of the insecticides resulted in the accumulation of lethal concentrations of toxic quinonoid metabolites in the tissues. Richter[13] has shown the general similarity between the catechol oxidazes in plants, fungi and insects, and has found that oxygen uptake is greatly reduced by the *o*-quinone reaction products, which combine with the available catechol oxidase. However, these more specific factors in insecticidal action are beyond the scope of the present article and will be considered elsewhere.

This account is based on an investigation into the fundamental mode of action of insecticides and drugs which is being carried out by me at the Department of Colloid Science, Cambridge. I wish to express my deep indebtedness to Prof. E. K. Rideal and to Dr. J. H. Schulman for much helpful advice and stimulating discussion, especially on the physico-chemical aspects of the work.

[1] Läuger, P., Martin, H., and Müller, P., *Helv. Chim. Acta*, **27**, 892 (1944).
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OBITUARIES

Miss E. R. Saunders

WHEN Edith Rebecca Saunders died on June 6 at the age of eighty as the result of a bicycling accident in Cambridge, there passed one to whom many scientific women owe a great debt for her labours on their behalf in the early days of the higher education of women. Others have written of the value of her botanical research work, but not the least valuable part of her services was the organization and training of many generations of science students at Girton and Newnham Colleges.

In the early days of the higher education of women at Cambridge, the University lectures were not open to women and the teaching of science was left entirely to the women's colleges to provide as best they might. Friends of the women helped when they could, but there was no help from the University as such. Very soon after Miss Saunders had taken her Tripos she was appointed demonstrator in biology at Newnham College and taught the students of both Girton and Newnham Colleges; later she became a lecturer, and together with the late Mrs. Bidder (Marion Greenwood) helped to organize all the practical work in biology and botany given in what came to be known as the Balfour Laboratory. This building, a former Nonconformist chapel given to Newnham College by the generosity of Mrs. Sidgwick and Miss Balfour in memory of their brother Francis Maitland Balfour, the zoologist, was converted into the Balfour Laboratory under the direction of Miss Greenwood and Miss Saunders, and here Miss Saunders taught for many years, becoming its director after Miss Greenwood's marriage to Dr. Bidder.

She always set before her pupils a high standard, and much excellent work was carried out by them there. Even after many University professors and lecturers opened their lectures to women, all the practical work for Part I of the Tripos was still organized and carried out by her, until the new University Laboratories were built and accommodation provided in them for the women students.

There must be many women employed in scientific work in universities, colleges, schools and other places all over the world who know that they owe their present position and success largely to the stimulus of Miss Saunders' teaching and the high quality of the work on which she insisted.

G. L. ELLES.
ETHEL SHAKESPEAR.

THE main writings of Miss E. R. Saunders relate to floral morphology. The most important of them were issued between 1923 and 1936 in the *Annals of Botany*, the *New Phytologist*, the *Journal and the Proceedings of the Linnean Society*, the *Journal of Botany* and the *Journal of Genetics*, and in two volumes published by Messrs. Heffer and Sons. The earliest of them furnished a factual basis for a new and interesting outlook on gynœcial morphology; the later documents elaborated a theory of carpel polymorphism and brought to focus important problems of systematic and evolutionary interest which are still unsolved.

The first of these writings appeared at a time when some rendering of the classical conception of a monomorphic carpellary 'leaf' gave contentment to many inquirers. They looked on such an organ as the basic unit of gynœcial construction in all groups of flowering plants and thought of it as possessed of a median style and a distal stigma. Whatever was their mode of approach to floral matters, their common purpose was to settle long-standing differences of opinion regarding the 'basic numbers', arrangements and forms of such 'leaves' for all types of 'syncarpous' gynœcia and to furnish for each alliance a 'fundamental ground-plan of floral construction'.

Few indeed were prepared to describe precisely the 'foliar' prototypes of which they spoke; but many acted on the view that such common 'free' carpels as follicles and achenes exemplified their units and demonstrated some of the ways in which still older organs had been transformed, reduced in numbers, aborted or suppressed, and gradually rearranged on some uniform specific plan. Despite their union in pistils, they still showed, per species, a single carpel-form. Nevertheless, although there was constant reference to facts of development and histology and to all manner of final forms of pistil, opinion on gynœcial construction had come no nearer to harmony than it had been from the days of Braun and Eichler to those of Kerner and Klein.

The bearing of Miss Saunders' views may be made plain through a few points of past interest. Thus, while some believed that facts of development were of great value in the interpretation of all organs, others considered that adult form and structure gave the surest guide. There was also a mode of thought which gave prominence to vascular tissue not only as a major index to the status of an organ but also as a sign of its modification, or as a pointer to its prior development in a given position. There was a common language explaining the arrangement of vascular strands, their modes of branching, the remarkable conservatism of a vascular system, and the usefulness of 'vestigial' strands in tracing the old sites of arrested organs. Further, some believed that a leaf may be truly terminal since, as they said, a legume is a unit carpellary leaf and is fully distal. Others rejected this view and regarded a legume as the sole and displaced survival of a lateral group of 'leaves'. They read all 'syncarpous' gynœcia according to their notions of numbers and arrangements of lateral leaves, of those which had been suppressed, and of those which were now displaced.

Miss Saunders entered this field convinced that there could be no agreement on a 'fundamental ground-plan' for any pistillate family so long as the concept of a monomorphic carpel was the starting point in phyletic discussion. She pointed, in particular, to the unsettled controversies over pistil construction in the Cruciferæ and other affinities, to the seemingly insoluble problem of the 'commissural' stigma, to the varying interpretations of obdiplostemony, to the wide range of ovule placentation still unexplained, and to the difficulties facing all monomorphists when they turned to families with 'supernumerary' styles. For these and all related matters she claimed the need of a new approach.

Her first proposal was as startling as it was simple, in that it visualized carpel dimorphism as shown to-day by many flowering groups. The heart of her view was that even a single pistil comprises united leaves; some with the form and the function of ovule-bearing organs, others of distinctive form and the function of which is stigmatic. Through this she sought early to rationalize cruciferous and other gynœcia and to explain the presence of commissural stigmas. As did others who opposed her plan for an extension of a 'leafy' view of carpels, she relied largely on the form and vasculation of mature organs. She came to identify and arrange her united carpel forms according to her estimate of branched or unbranched vascular strands, the positions of ovules upon ovarial walls, the arrangement of stigmas, and the older conception of the cyclic construction of a flower. It was inevitable that she should reject the conception of a terminal leaf once she had decided to interpret a distal legume as a union-product of distinctive carpel forms. Also it was natural that, with strands as a major instrument in the identification of unit organs, she extended her dimorphic view into a doctrine of carpel polymorphism. One cannot attempt to outline the many directions in which she sought later to apply her theory and to settle once and for all the fundamental ground-plans of floral construction on which she had set her heart. But her final volumes are in themselves a glowing testimony to the breadth of her inquiries, to her courage, and to the great array of facts which she disclosed.

It may be long before there is common agreement as to the chief objective of floral study and the valuation of the evidence on which Miss Saunders relied. But it may truly be said that few of her contemporaries in formal morphology stirred imagination more deeply than she, or did so much to stimulate inquiry. J. McL. Thompson.

Mr. H. E. Potts

The very narrow but nevertheless important field of patent law and practice has lost a great mind by the death of Mr. H. E. Potts on July 4. He was an earnest and original contributor to the literature of patent law. Early in his career as a chartered patent agent, he was struck by the fact that, in the drafting of patent specifications and claims, a patent agent had to call upon powers of analysis and then subsequent synthesis, and that this logical process should have some analogy in mathematics. His first contribution on "An Application of Mathematics to Law" was indeed to *Nature* of April 24, 1913 (p. 187), and this has been followed over the years by a development of the idea there lightly touched upon.

Although possibly never hitherto positively appreciated, it is nevertheless a fact that a patent granted upon an invention when tested by the High Courts of Great Britain is either 'wholly bad' or 'wholly good'. It is believed that Mr. Potts was the first to point out that there should be some method of assessing validity quantitatively, as well as qualitatively; and recently he put forward a number of suggestions in regard to the appreciation of monopolies of invention as granted by the Crown on a graduated basis, as distinct from the 'all good' or 'all bad', developing this proposition side by side with its mathematical exposition and following accepted theories of modern philosophy.

Of many valuable publications, perhaps Potts' best known is his book "Patents and Chemical Research", which has become a standard work in the literature on patents.

We regret to announce the following deaths:

Mr. A. D. E. Elmer, the distinguished plant collector and author of many papers on the botany of the Philippines, in July 1942.

Dr. Frank Blair Hanson, associate director for the natural sciences at the Rockefeller Foundation, formerly professor of zoology at Washington University, St. Louis, on July 21, aged fifty-nine.

Dr. Gustave M. Meyer, associate in biochemistry during 1913–41 at the Rockefeller Institute for Medical Research, known for his work on carbohydrates and tissue chemistry, on May 9, aged sixty-nine years.

The Ven. Lonsdale Ragg, founder and editor of the *Tree Lover*, and known for his drawings of trees, on July 31, aged seventy-eight.

NEWS and VIEWS

New Linacre Professor at Oxford : Prof. A. C. Hardy, F.R.S.

PROF. A. C. HARDY, whose recent appointment as Linacre professor of zoology and comparative anatomy at Oxford has been announced, is especially distinguished for his work in the sphere of oceanography. He is a leading authority on marine plankton, and throughout his researches has stressed the ecological aspect. Prof. Hardy started his career as a member of the Ministry of Agriculture and Fisheries Research Staff at Lowestoft in 1921, working on the natural history of the herring in relation to the plankton. In 1924 he joined the research staff of the *Discovery* as chief zoologist under the late Dr. Stanley Kemp. He went on the Antarctic voyage of 1925–27, and published, with the late Dr. E. R. Gunther, important results on the ecology of plankton animals in southern waters. These included studies of animal and plant interrelations (developing his hypothesis of animal exclusion), 'patchiness' of plankton, correlations of whale and plankton distribution, vertical migration and the combined effect of this with varying current systems at different depths.

In 1928 Prof. Hardy became the first professor of zoology and oceanography at the University College of Hull, where he developed on a large scale the use of his continuous plankton recorder, which he had originated while with the *Discovery*. He also demonstrated herring-plankton distribution correlations with his smaller plankton indicator, which has now become a commercial instrument. In 1942, Prof. Hardy was appointed regius professor of natural history in the University of Aberdeen. In recent years he has widened his interests to include the air, undertaking research on the aerial plankton, for which he has devised gear for catching insects in the upper air from kites and aircraft. Prof. Hardy is thus well fitted to help and enlarge the scope of the well-known ecological researches already being carried out at Oxford.

British Cotton Industry Research Association Fellowships

THE Council of the British Cotton Industry Research Association has decided to make an annual award of a limited number of research fellowships with the object of training young men in research methods in pure science, and particularly those branches of prime interest to the Association. The Association conducts research into the utilization of cotton, rayon, silk and synthetic fibres, and examples of scientific fields of present interest to the Association are: carbohydrate and protein chemistry; fundamental studies of high polymers; photochemistry; fundamental physical studies relating to properties of matter or electronics; theory of instrumentation; mathematics; studies on the colloidal state. The fellowships will be open to graduates of British nationality and will be tenable at any British university. Their value will depend on circumstances, but will not in any case be less than £200 per annum. The Association will be guided in its choice of the location of fellows chiefly by the type of research conducted by the professor under whose direction the candidate elects to work. Application for election to a fellowship should therefore be made through the professor and should be accompanied by a statement of the problem to be studied. It will be normal for the Association to wish to interview candidates, but the recommendation of the professor will be an essential and will carry great weight in the selection. Applications should be forwarded to the Director, British Cotton Industry Research Association, Shirley Institute, Didsbury, Manchester, not later than two months before the commencement of the work.

The object of the fellowships being to train young graduates in fundamental research methods, they will not be awarded for specific problems in connexion with industry. Further, the results of researches carried out with the assistance of a fellowship will be published from time to time in the scientific journals at the discretion of the professor directing the work, and if deemed by him worthy of such action. The only condition attaching to publication will be that suitable acknowledgment shall be made by authors of the receipt of a fellowship. Without in any way implying direction of or interference with the research, the Association would wish to feel free through its director of research to discuss progress with fellowship holders from time to time, and fellows would be given opportunities to visit the Association's laboratories, and thus become acquainted with the problems of the textile industries. Save in exceptional circumstances, the Association will not make more than two consecutive annual grants to the same person.

College of Aeronautics

THE following have been appointed to be the Board of Governors of the College of Aeronautics for postgraduate instruction in aeronautical science and engineering, which, as announced in the House of Commons in October last, is being created in accordance with the recommendations of the Committee presided over by Sir Roy Fedden, the report of which was issued last year: Air Chief Marshal Sir Edgar Ludlow-Hewitt (*chairman*), Dr. W. Abbott, Mr. H. Burroughes, Sir Roy Fedden, Mr. J. Ferguson, Sir Harold Hartley, Sir William Hildred, Sir Melvill Jones, Dr. E. B. Moullin, Mr. J. D. North, Sir Frederick Handley Page, Mr. E. F. Relf, Dr. H. Roxbee-Cox, The Lord Selkirk, Air Marshal Sir Ralph Sorley, Sir William Stanier, Rear-Admiral T. H. Troubridge and Mr. W. E. F. Ward. Invitations are being extended to the Governments of the Dominions and India which may wish to be associated with the College to appoint representatives on the Board of Governors. Preliminary steps are now being taken with the view of opening the College some time in the course of next year in temporary accommodation to be provided at Cranfield, pending the provision later of permanent premises.

Sensory Devices for the Blind Committee

THE Council of St. Dunstan's has set up a committee to be known as the Sensory Devices for the Blind Committee, and the following have agreed to serve: Prof. E. D. Adrian, professor of physiology, University of Cambridge (*chairman*); Dr. Clifford Paterson, director of the Research Laboratories, General Electric Co., Ltd., Wembley; Mr. Thomas Smith, superintendent of the Light Department, National Physical Laboratory; Flight-Lieut. E. Barton; Dr. B. H. C. Matthews, head of the R.A.F. Physiology Laboratory, Royal Aircraft Establishment, Farnborough; Mr. H. L. Kirke, head of the Engineering Research Department, B.B.C.; and Sir Ian Fraser. The Committee has had two preliminary tings and on its advice St. Dunstan's has decided et up a Research Unit and to seek the full-time ices of a research physicist and a biologist. ough the generosity of an anonymous benefactor, bstantial sum of money has been made available the work of the Committee over a period of five rs. The Committee will not only investigate ling devices for the blind but also methods where- the printed word in an ordinary book can 'read d' to the blind; the improvement of recorded ing books; braille machines, and other apparatus. research work will include the better use of the e glimmer of sight which remains with many ple who are technically blind, and the sub- ation of the sense of sight by the other senses.

alization in the Visual Cortex

R. Gordon Holmes, in his Ferrier Lecture before Royal Society on "The Organisation of the Visual tex in Man" (*Proc. Roy. Soc.*, B, 132, 348; 1945), lt chiefly with the question of localization within visual area of the cerebral cortex. As he himself shown, by study of the visual-field defects result- from gunshot wounds of the cortex, there is arently a very sharp point-to-point representa- of the retina in the cortex. The conception of nite fixed anatomical connexions between each at of the retina and the corresponding point in cortex has been supported by recent histological lies of the actual nerve fibre connexions, particu- y by Le Gros Clark. Such a rigid fixed relationship ween retina and cortex would appear, however, stand in marked contrast to the situation in other ts of the cortex, notably the motor area, where alization is by no means sharp and undergoes con- erable physiological variations. But more recent ical studies have shown that there must be a d deal of plasticity in the functional organization the visual cortex. For example, patients suffering m hemianopia compensate for the loss of half the ual field by developing a new fixation point ('false cula') in the centre of the surviving field of vision; imilar adaptation occurs in a squinting eye. In h cases there must be a complete functional rganization in the cortex, though the fibre con- xions, of course, cannot change. The conclusion that, although there is an accurate point-to-point resentation of the retina in the cortex, the func- nal organization of the visual cortex is not thereby idly fixed; on the contrary, it exhibits consider- e plasticity.

cent Earthquakes

During April and the early part of May 1945, the ited States Coast and Geodetic Survey, in co- eration with Science Service and the Jesuit ismological Association, determined the provisional icentres of five earthquakes. The first two occurred April 15, the first at 2h. 35·2m. G.M.T. and the ond at 19h. 50·6m. G.M.T. The former had an centre at lat. 56° N., long. 164° E., which is east Kamchatka, and the latter an epicentre at lat. ·5° N., long. 108·0° W., which is off Mazatlan, xico. The third earthquake was on April 19 at h. 03·5m. G.M.T. from an epicentre near lat. 40° S., ng. 179° E., which is east of New Zealand. The rthquake of April 21 at 17h. 14·5m. G.M.T., accord- g to the calculations based on reports from twelve rthquake observatories (instrumental), had its epi- ntre at lat. 19·3° N., long. 100·6° W. Its depth of cus was below normal, probably 50–100 km. below the surface of the earth. The earthquake was felt in Mexico. The fifth earthquake was on May 19 at 7h. 55·8m. G.M.T. The provisional epicentre, based on instrumental reports from eight observatories, has been estimated at lat. 16·0° N., long. 98·4° W., which is west of Mexico.

Mr. E. W. Pollard, at his observatory at Binstead, Isle of Wight, registered five earthquakes during April, the first on April 15 being the greatest. May is reported as being a very quiet month, only two earthquakes being recorded, on May 9 and 19. The former was small and the latter medium strength.

Localization of Faults in Low-Voltage Cables

Practical limitations of well-known fault-locating tests are considered, and some new tests capable of high accuracy are described, in a paper read by J. H. Savage recently before the Institution of Electrical Engineers in London. The new tests include a D.C. valve-voltmeter circuit for core-to-sheath insulation faults, audio-frequency search methods for open circuits and radio-frequency tests for conductor defects. Mention is also made of fault localization based on wave-reflexion effects. The paper deals mainly with factory technique for rubber- and plastic-insulated cables; but some of the methods can be applied to other types and to field work. As faults on cables carrying current are accompanied by local changes of electric and magnetic fields, and circuit unbalance and wave reflexions can be produced, future developments are likely to be in the direction of electronic devices, because these are eminently suitable for detecting and recording such effects.

Chinese Visitors to Britain

Eight Chinese visitors of widely varying professions are visiting Britain as guests of the British Council: Dr. Wang Ging-Hsi, director of the Institute of Psychology of the Academia Sinica, a well-known Chinese physiologist; Dr. Sah Pen-Tung, president of the National University of Amoy, Fukien, who is a physicist especially interested in radio-engineering; Dr. Yang Chen-sheng, professor of Chinese literature, and acting dean of the College of Arts of the National University of Peking; Prof. Tung Li Yuan, librarian of the National Library, Peking; Colonel (Mrs.) Chow Mei-You, head of the Nursing School in the Army Medical School; Miss Gao Ren-Ying, acting national general secretary of the Chinese Y.W.C.A., who is studying social conditions in Britain; Miss Priscilla Huang and Miss Chi-yi Chen, both of whom are interested in children's and women's welfare and all services of rehabilitation of war casualties.

Canadian Awards for Postgraduate Training

The National Research Council of Canada is providing opportunities for postgraduate training in science for men and women whose studies have been delayed or interrupted by war service, either military or civilian. Three classes of award are available for the academic year 1945–46 as follows: bursaries (450 dollars) for students who have graduated with high distinction in scientific subjects; studentships (750 dollars) for students who have had experience in research work in science for at least one year following graduation; fellowships (900 dollars) for students who have given distinct evidence of capacity to conduct independent research in science. One group of applications is under consideration and awards will be announced before October 1, 1945. Additional applications received by November 15, 1945, will be considered and awards announced by December 31, 1945. Detailed information with respect to these awards and a copy of the required application form may be secured upon written application to the Secretary-Treasurer, National Research Council, Ottawa.

University of Durham: Appointments

DR. A. C. OFFORD has been appointed to the chair of mathematics in the Newcastle Division of the University of Durham. Dr. Offord was born in 1906, and was educated at University College, London, and at St. John's College, Cambridge, where he was elected to a fellowship. He has also been a lecturer at the University College of North Wales, Bangor. He joined the Mathematics Department at King's College, Newcastle-upon-Tyne, in 1941. His published work includes papers on the theory of divergent series, Fourier transforms, trigonometric intervals and the application of methods of the theory of probability to algebraic equations; he has also done work on integral functions.

Mr. W. H. F. Barnes has been appointed to the chair of philosophy in the Durham Division of the University of Durham. Mr. Barnes is thirty-six years of age. He was educated at Corpus Christi College, Oxford, where he was awarded the Haigh Scholarship in classics and the John Locke Scholarship in mental philosophy. He also held for two years a Senior Demyship at Magdalen College. Since 1936 he has been assistant lecturer and then lecturer in philosophy at the University of Liverpool. During 1941–42 he was in the R.A.F. and thereafter took a post as administrative officer in the Ministry of Supply. His published works include papers in periodicals on values, meaning and verifiability, action, Berkeley and Locke, and Richard Price.

University of London: Appointments

THE following appointments have been made in the University of London: Mr. Raymond Irwin, county librarian of Lancashire, to be director of the School of Librarianship at University College; Dr. John Yudkin, recently supervisor in biochemistry and physiology at Christ's College and Emmanuel College, Cambridge, to the University chair of physiology tenable at King's College of Household and Social Science; Dr. L. Dudley Stamp, since 1926 Sir Ernest Cassel reader in economic geography at the London School of Economics and Political Science, to the chair of geography at the School.

Announcements

DR. H. J. GOUGH, who has just been released by the Ministry of Supply (*Nature*, Aug. 11, p. 168), is joining Lever Brothers and Unilever Ltd. as engineer-in-chief, and will shortly take up his duties at Unilever House.

THE Nuffield Foundation has made a grant of £1,045 a year for five years for the stipend and pension contributions of a special research fellowship for Dr. E. Orowan to enable him to continue his work in the Cavendish Laboratory, Cambridge, on the plastic properties of metals; in addition, the Foundation will provide £455 a year for the same period towards the cost of the fundamental research work undertaken by him.

THE next three graduate memberships of the R Institution, open to recent graduates, of either of any university in the British Empire who l taken a degree with either first or second c honours in any scientific subject, will shortly awarded by the managers of the Institution. T memberships give the holder the privileges of att ing all lectures delivered in the Institution and use of the Library. Application forms can be obta from the General Secretary, Royal Institution Albemarle Street, London, W.1.

THE Gas Light and Coke Company has decide broaden the basis of its research programme an arrange for improved co-ordination of effort wi the Company. Dr. H. Hollings, hitherto the c gas chemist of the Company, has been appoi controller of research, and he now becomes respons for the activities of Watson House as well as t of the Fulham Research Laboratory. The follov further appointments have also been made: Mr. Dieterichs to be manager, Watson House; Mr. G Holliday to be manager, Gas Light Centre; R. H. Griffith to be senior research chemist; S. Pexton to be senior chemical engineer.

AT the annual meeting of the Genetical Soci the following officers were elected: *President*, C. D. Darlington; *Vice-Presidents*, Prof. R. Fisher, Mr. M. B. Crane and Dr. J. Hammo *Acting Treasurer*, Dr. D. G. Catcheside; *Secreta* Mr. W. J. C. Lawrence, John Innes Horticult Institution, Mostyn Road, Merton, London, S.W. and Mr. R. R. Race, Galton Laboratory Serum U at the Department of Pathology, University Cambridge.

MR. J. E. C. BAILEY, chairman and manag director of Baird and Tatlock (London), Ltd., been elected president of the Scientific Instrum Manufacturers' Association of Great Britain succession to Mr. Frank Wakeham, who retires a three years of office. Mr. Bailey is a member of Admiralty Chemical Advisory Panel, of the Co mission on Scientific and Laboratory Equipment the Conference of Allied Ministers of Education, of several committees of the British Standa Institution. Other officers of the Association a *New Vice-Presidents:* Mr. J. Hasselkus (Ross, Lt Mr. Frank Wakeham (Cambridge Instrument Ltd.), Mr. T. J. Offer (Chas. Baker); *Hon. Treasur* Mr. S. Borthwick (R. and J. Beck, Ltd.); *H* *Secretary:* Mr. G. A. Whipple (E. R. Watts and S Ltd.); *Members of Council:* Mr. H. A. Ca (J. H. Dallmeyer, Ltd.), Mr. G. A. Heed (A. Kersl and Sons, Ltd.), Mr. A. J. Hughes (Henry Hughes Son, Ltd.), Mr. J. Loxham (The Sigma Instrum Co., Ltd.), Major G. McAlpine (Kelvin, Botto and Baird, Ltd.), Mr. E. C. Sherren (Un Kingdom Optical Co., Ltd.); Mr. M. H. Ta (Taylor, Taylor and Hobson, Ltd.), Mr. H. A. Trepte (W. and J. George and Becker, Ltd.), W. N. Wheat (Chance Bros., Ltd.), Mr. H. H. Z (G. H. Zeal, Ltd.).

ERRATUM.—In the communication "Abnor Lignification in the Wood of some Apple Trees", Dr. A. Beryl Beakbane and Dr. Eleanor C. Thomps in *Nature* of August 4, p. 145, Fig. 1 has been invert that is, the section of the 'rubbery' branch is t marked (*a*).

LETTERS TO THE EDITORS

e Editors do not hold themselves responsible r opinions expressed by their correspondents. o notice is taken of anonymous communications.

Penicillin in Leishmania Infections

HE action of penicillin on leishmania infections not so far been reported in the literature. This deals with the treatment of four hamsters in- ed with an Indian strain of the parasite which previously been employed by me in chemo- apeutic tests[1]. The methods used were the same hose already described. The Golden Hamster *cetus auratus*) is the most suitable animal for erimental studies of this infection, since in their the disease, so far as is known, never shows ntaneous regression and finally causes death. The *itro* action of penicillin on tissue forms of the asite and on flagellate forms in young and old ures is also described. Thanks are due to the icillin Clinical Trials Committee of the Medical earch Council for a supply of material.

he animals weighed 60–80 gm. Two were treated the calcium salt of penicillin in saline three es daily over a period of eight days with doses 00 Oxford units at 3–4 hour intervals, partly by intraperitoneal and partly by the subcutaneous te. Two others received half this amount in the e way, the total dose for each of the two pairs g 9,600 and 4,800 Oxford units respectively, ch corresponds to 6–3 million units for a man of mal weight. The drug was tolerated without any oward symptoms. The spleen infections before atment varied from 5 to 200 Leishman-Donovan lies per field, as seen under oil immersion with × 10 eyepiece, and when smears were examined days after the end of treatment it was found that infections had progressed in the same way as se in two control animals. The drug had there- e exercised no influence on the course of the in- tion and parasitic cell division had taken place rmally. In the case of bacteria, Bigger[2] has gested that penicillin affects only dividing cells. rrod[3], from his experiments, considers that the idence on this point is conflicting. It is, wever, not certain that the drug can penetrate splenic cells which normally contain these tissue rms.

In four *in vitro* experiments, infected splenic tissue m hamsters was cultured for six to seven days media at 25° C. which contained penicillin in rious dilutions. A suitable number of control bes were used at the same time. The results are corded in Table 1. Accurate counts of flagell- es could not readily be made since they tend become agglutinated in masses under these nditions.

From Table 1 it will be seen that development of gellates took place in all the culture tubes in which e concentration of penicillin was less than 50 units er c.c , and growth proceeded as in the controls. At at concentration flagellates failed to develop in me tubes and the percentage of failures increased ith higher concentrations of drug. It should be oted that the upper concentrations are greater than hose likely to be obtained in the blood in clinical ractice. After seven days incubation it was found y the agar-cup method that in the highest con- entrations about 50 per cent of the penicillin originally present had disappeared. According to Bigger, the maximum effect of penicillin is exerted near body temperature, but culture of leishmania at 37° C. has not so far been found possible. The results suggest that the drug in the highest concentrations used had exerted some action on the parasite, but our penicillin sample contained only 150 Oxford units per mgm. and the impurities present may have influenced the results.

TABLE 1. HAMSTER SPLEEN INFECTED WITH *L. donovani* CULTURED IN PRESENCE OF PENICILLIN.

Units of penicillin per c.c. of medium	No. of experiment				Totals
	1	2	3	4	
400				5−	5−
200			5−	2+ · 2−	2+ . 7−
50	2+ . 2−	1+ : 4−	5+	7+	15+ : 6−
12·5	3+	6+	6+	7+	19+
3·2		6+	6+		12+
0·8		4+	6+		10+
0 2		5+	6+		11+
Controls	3+	6+	4+	5+	18+
No. of parasites per field in each hamster spleen cultured	1	300	200	40	

+ = active flagellates present.
− = flagellates absent.

Some further experiments were made with flagellate cultures of different ages. Inocula of equal size of young flagellate cultures were sown in media containing penicillin at similar concentrations to the above, as well as in control tubes. After incubation at 25° C. for six to seven days, the contents of the tubes were examined and rough counts made of the number of flagellates present. It was found that the flagellates in tubes containing penicillin were as active as, and their numbers differed but little from, those in the control tubes. These results are summarized in Table 2.

TABLE 2. ACTION OF PENICILLIN ON FLAGELLATE FORMS OF *L. donovani* IN CULTURE MEDIUM.

Units of penicillin per c.c. culture medium	400	200	50	12 5	3·2	Controls
Total no. of tubes used for each conc. of drug	8+ : 1−	13+ : 1−	13+	13+	4+	10+

+ = active flagellates present.
− = flagellates absent.

It will be seen from Table 2 that only in two tubes containing penicillin did flagellates fail to survive six days. We consider that the drug had no action on these forms even at the high concentrations used.

In a final experiment penicillin, in the same medium, was added to six-day old cultures of flagellates to give a concentration of 400 Oxford units per c.c. Four tubes maintained at 25° C. for four days showed no diminution in numbers or activity compared with controls.

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July 10.

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A Thermostabile, Fungistatic Factor from *Escherichia coli*

WHEN cultivating *Penicillium notatum* Westl. and related fungi for the purpose of producing penicillin, it was soon noticed that the production of penicillin was inhibited by certain bacteria. It was proved that this was due to the fact that the bacteria in question formed an apparently enzymatic substance able to destroy penicillin. This substance, which was called penicillinase, was first demonstrated by Abraham and Chain[1] in *Esch. coli* and *M. lysodeikticus*. It was later found in paracolon bacilli[2], in *B. subtilis*[3,4], in penicillin-resistant staphylococci[5], as well as in various other micro-organisms[6,7,8]. In addition, commercial preparations of taka-diastase and clarase were found to have a similar effect[9,10]. Preparations of penicillinase, like those of other enzymes, are more or less thermolabile. The penicillinase from *Esch. coli*, for example, is easily destroyed by heat[1], whereas that from *B. subtilis*, on the other hand, seems to be more stable[3].

Occasionally the production of penicillin was found to be partly or completely inhibited from other causes which could not be determined.

An interesting observation in this connexion was made here about two years ago in experiments with the cultivation of *Penicillium notatum*. In some cases, in which the nutrient medium was not sterilized immediately after its preparation, but was allowed to remain a short time at room temperature before autoclaving, the rate of growth of the fungus decreased, with the result that the production of penicillin also decreased. (Disturbances in the production of pigment by the fungus were also noted.) Evidently some species of the micro-organisms which had developed before the medium was autoclaved had produced a thermostabile substance with fungistatic activity.

In later experiments to determine the ability of a number of bacteria to produce a substance of this kind, it was found that a strain of *Esch. coli* possessed this ability to a marked degree, particularly when the following medium was used: asparagine 2 gm., $NaNO_3$ 3 gm., KH_2PO_4 6·5 gm., $Na_2HPO_4,12H_2O$ 33·5 gm., KCl 0·5 gm., $MgSO_4,7H_2O$ 0·5 gm., $FeSO_4,7H_2O$ 0·01 gm., glucose 40 gm., casein hydrolysate solution (Mueller) 2 ml., distilled water to 1 litre.

The growth of *Penicillium notatum* was excellent in this medium, which was sterilized by autoclaving at 120° C. for twenty minutes, and after about seven days at room temperature a compact layer had been formed which completely covered the surface of the medium in the culture vessels. But, if after sterilization the medium was inoculated with *Esch. coli*, incubated at 37° C. for 24 hours, and autoclaved again at 120° C. for twenty minutes, the rate of growth of the fungus was found to be greatly reduced. Not until about seven days after inoculation could signs of growth be observed in the form of small, scattered, star-like, white figures around the wall of the vessel at the level of the surface of the medium. The later growth was also very slow.

The differences in the sugar concentration and the *p*H, respectively, between the medium in which *Esch. coli* had been cultivated and the original medium were not significant, and the reduction in the rate of growth can therefore not have been due to any variation in these respects. It was also proved that with the exception of the inoculation with *Esch. coli* the treatment of the medium (incubation at 3 and autoclaving) did not cause the inhibition growth. Since all the substances necessary for nor growth were present, some fungistatic factor, w also was thermostable, must have been produced

This fungistatic factor can be produced in o media also, for example, broth, but not to the s extent as in that stated above.

The factor in question was found to be without effect in the assay of penicillin by the cylinder-p method (modified according to Wiedling[11]). It t differs from penicillinase not only in its ther stability, but also in that its effect on the product of penicillin is caused by a reduction in the rat growth of the fungus and not by actual destructio the penicillin. The thermostability of the factor distinguishes it from most other bacterial fungistat which usually are thermolabile[12].

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April 28.

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A New Occurrence of the Electronic Phase Velocity

STARTING with the Lorentz equation:

$$\frac{d}{dt}\,(m\mathbf{v}) = e\,\left\{\mathbf{E} + \frac{[\mathbf{vH}]}{c}\right\} \quad . \quad . \quad . \quad ($$

we have, after scalar multiplication by **v**, which at right angles to the vector product [**v**,**H**],

$$\frac{d}{dt}\,(\tfrac{1}{2}mv^2) = e\mathbf{vE} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad ($$

Replacing **E** in terms of φ and **A**,

$$\frac{d}{dt}\,(\tfrac{1}{2}mv^2) = -\,e\left(\mathbf{v}\nabla\varphi + \frac{\mathbf{v}\dot{\mathbf{A}}}{c}\right); \quad . \quad . \quad ($$

where **A**, the vector potential, satisfies

$$\mathbf{H} = \text{curl}\,\mathbf{A} \text{ and } \nabla A + \dot{\phi}/c = 0 \quad . \quad . \quad . \quad ($$

We next write in (3) for its rearrangement

$$\mathbf{v}\nabla\varphi = \frac{d\varphi}{dt} - \dot{\phi}, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad ($$

so that the total energy changes at the rate

$$\frac{d}{dt}\,(\tfrac{1}{2}mv^2 + e\varphi) = e\dot{\phi} - \frac{e\mathbf{v}\dot{\mathbf{A}}}{c}. \quad . \quad . \quad . \quad ($$

Now, using (4), this may be written

$$\frac{d}{dt}\,(\tfrac{1}{2}mv^2 + e\varphi) = -\,ec\left(\nabla\mathbf{A} + \frac{\mathbf{v}}{c^2}\dot{\mathbf{A}}\right) \quad . \quad ($$

Next, let us seek the consequences of supposin $(\tfrac{1}{2}mv^2 + e\varphi)$ to be constant, both in space and tim This means, from (7),

$$\nabla\mathbf{A} + \frac{\mathbf{v}\dot{\mathbf{A}}}{c^2} = 0\,; \quad . \quad . \quad . \quad . \quad (8$$

so

$$m\mathbf{v}\dot{\mathbf{v}} + e\phi = 0. \quad . \quad . \quad . \quad . \quad (9)$$

dding (9) to ec times (8) we have:

$$\mathbf{v}\left(m\dot{\mathbf{v}} + \frac{e\dot{\mathbf{A}}}{c}\right) + ec\left(\nabla\mathbf{A} + \frac{\dot{\phi}}{c}\right) = 0. \quad . \quad (10)$$

ut, by (4), the last bracket vanishes. Thus, aside om the trivial result $\mathbf{v} = 0$, we are left with

$$\dot{\mathbf{p}} = 0, \quad . \quad . \quad . \quad . \quad . \quad . \quad (11)$$

here

$$\mathbf{p} = m\mathbf{v} + \frac{e\mathbf{A}}{c} \quad . \quad . \quad . \quad . \quad (12)$$

is the sum of the mechanical and electromagnetic omentum associated with each particle. Thus, in der for the energy of a particle to be conserved, (11) ust hold good; but this need not mean that both $\dot{\mathbf{v}}$ d $\dot{\mathbf{A}}$ must separately vanish. Thus $\dot{\phi}$ need not be ro in (9), so that $\nabla\mathbf{A}$ need not be zero. Then (8) ay be regarded as having a non-trivial solution. the variable part of $\mathbf{v}$ is small compared to the art which is constant in time and space, a close pproximation to this solution is the plane wave

$$\mathbf{A} = \psi\,(\mathbf{s} - \mathbf{u}t), \quad . \quad . \quad . \quad (13)$$

here

$$\mathbf{u} = c^2/\mathbf{v}, \quad . \quad . \quad . \quad . \quad . \quad (14)$$

is any function of the argument shown and $\mathbf{s}$ is ne vector distance.

Now if the beam is moving in a straight line, url $\mathbf{u} = 0$. Provided $\mathbf{A}$ is directed along $\mathbf{s}$, we shall hen have curl $\mathbf{A} = 0$. But this means no Poynting ector. Hence, for a beam of electrons moving with early uniform velocity in a straight line, electronic aves of a kind are predicted. These are A waves, et carry no energy away provided A is directed angential to the path of the electrons, which is also 's direction of propagation with wave velocity $\mathbf{u}$ nd group velocity $\mathbf{v}$.

In view of experiments leading us to infer for lectronic waves properties precisely the same as hose postulated for the electronic A waves, our discovery of these is perhaps not to be regarded as ortuitous.

If we regard the arbitrary part of the phase as governed by the experimental result

$$\lambda = h/mv, \quad . \quad . \quad . \quad . \quad . \quad (15)$$

ur solution may be written in the form

$$\mathbf{A} = \mathbf{s}_1\,\psi\left(\frac{mc^2}{\hbar}\,t - \frac{mvs}{\hbar}\right), \quad . \quad . \quad (16)$$

where $\hbar = h/2\pi$; $\mathbf{s}_1$ is a unit vector along $\mathbf{s}$.

In order to obtain A as a wave of velocity c, such s is obtained in atomic and wireless radiation, it is ecessary to depart from the principle that $\frac{1}{2}mv^2 + e\phi$ s constant. The terms on the right-hand side of (6) hen yield radiation of known type, of which the A-dependent part may travel to great distances; but before such result is obtained it is necessary to sum over all particles present in the field.

I should like to thank Prof. H. T. Flint for his interest and for suggesting the title of this note.

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Chromatography of Two Solutes

THE communication by Drs. Offord and Weiss[1] is of particular interest to me, as I am just publishing a paper on the same subject, though with different results.

Using the same definitions, we have the adsorption isotherms

$$q_1 = f_{(c_1c_2)} \quad , \quad q_2 = g_{(c_1c_2)} \,;$$

whence it follows from de Vault's equations[2] that

$$\frac{df_{(c_1c_2)}}{d_{c_1}} = \frac{dg_{(c_1c_2)}}{d_{c_2}} = \frac{v}{x} \quad \text{(see Offord and Weiss's equation 2)} \qquad (1)$$

Equation 1 defines the relationship between c_1 and c_2 in that part of the chromatogram where the concentrations vary. But without a complete solution of this simultaneous differential equation, no useful deductions can be drawn. Offord and Weiss's equation 3 for v/x which, if correctly deduced, should read:

$$v/x = g'_{(c_2)} -, \text{ etc.} \qquad (1.1)$$

unfortunately has no meaning, as it refers to definite sets of c_1 and c_2 (defined by eq. 1) and, without an integration, there is no way of knowing which value of c_1 belongs to any given c_2.

Fortunately, the only adsorption isotherm which offers a theoretically founded relationship between the amounts of multiple solutes adsorbed and in solution—the Langmuir isotherm—does permit of a solution of equation 1, resulting in a linear relation between c_1 and c_2.

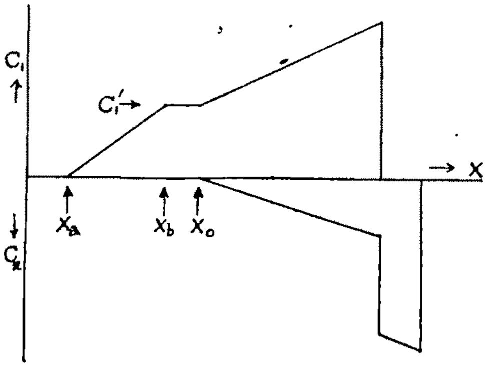
Taking $f = a_1c_1/(1 + b_1c_1 + b_2c_2)$ and $g = a_2c_2/(1 + b_1c_1 + b_2c_2)$ where $a_1 > a_2$, the solution of equation 1 is:

$$a_1b_2c_2 = a_2b_1c_1.\lambda - (a_1 - a_2)\lambda/(1 + \lambda), \quad . \quad (2)$$

where λ is an integration constant obtainable from equation 2 by inserting the initial conditions $c_1{}^0$ and $c_2{}^0$. This gives a quadratic equation with a positive and a negative root for λ. One of these applies according to whether dc_1/dc_2 is positive (trailing boundary of the less adsorbed material) or negative (forward boundary of the more strongly adsorbed material).

Equation 2 makes it possible to calculate exactly and in detail every stage in the development of the chromatogram, and this has been done in the paper referred to. After the disappearance of the original constant levels, the distribution is shown in the diagram (where diffusion phenomena which would reduce the sharpness of the front boundaries are not considered).

The chromatogram shown has three distinct parts: a pure frontal band of pure solute II, a mixed band,



and a rear band of pure solute I. The statement by Offord and Weiss that the same solute may appear both in the front and rear bands if its concentration greatly exceeds that of the other solute certainly does not apply to this type of isotherm. This phenomenon is not general, but occurs only when the two isotherms intersect, and when thus the same solute is more strongly adsorbed at low concentrations (rear) and less adsorbed at high concentrations (front).

Offord and Weiss's equation for the amount of pure solute in the tail band does not, as claimed, represent the total content, but only the amount between x_a and x_b. Consequently, their equation 7 for the volume of pure solvent required for total separation is also erroneous.

If the tail band containing pure solute I were not fed constantly from the mixed band, its forward edge would travel down the column in accordance with the equation:

$$\Delta v / \Delta x_0' = f_{(c_1' o)} / c_1' \quad . \quad . \quad . \quad . \quad (3)$$

(see Weiss[3]), while the rear end of the mixed band is given by

$$\Delta v / \Delta x_0 = f'_{(c_1' o)} \overset{c}{=} g'_{(c_1' o)} \quad . \quad . \quad . \quad (4)$$

where $f'_{(c_1' o)}$ and $g'_{(c_1' o)}$ stand for the complete differentials $[df/dc_1]_{c_2=0}$ and $[dg/dc_2]_{c_2=0}$ respectively.

To maintain a continuous chromatogram the amount fed into the tail band must therefore be

$$\Delta m_1 = (\Delta x_0 - \Delta x_0') \cdot f_{(c_1' o)}\,; \quad . \quad . \quad (5)$$

whence it follows that, for complete separation, the volume V of solvent required is given by

$$m_1 = v^0 \cdot c_1^0 = V \cdot \left(\frac{f_{(c_1' o)}}{g'_{(c_1' o)}} - c_1' \right); \quad . \quad (6)$$

while the minimum length of column required for complete separation is

$$L = V / g'_{(c_1' o)} = m_1 / (f_{(c_1' o)} - c_1' \cdot g'_{(c_1' o)}) \quad . \quad (7)$$

Equations 6 and 7 are, however, almost without practical value unless c_1' is known, and this can so far be calculated for Langmuir isotherms only, where

$$c_1' = (a_1 - a_2)/a_2 b_1 (1+\lambda) = \delta / b_1 (1+\lambda), \quad . \quad (8)$$

where $\delta = (a_1 - a_2)/a_2$. This leads to

$$V = m_1 b_1 (1+\lambda)/\delta^2 \text{ and } L = m_1 b_1 (1+\lambda+\delta)/a_2 \delta^2. \quad (9 \text{ and } 10)$$

It follows from equation 2 that λ assumes simple values when $b_1 c_1^0 \gg \delta$ and when $b_1 c_1^0 \ll \delta$. In the first case, corresponding to solutes difficult to separate, $\lambda = a_1 b_2 c_2^0 / a_2 b_1 c_1^0 = \text{approx. } c_2^0 / c_1^0$; whence

$$V = \sim b_1 (m_1 + m_2)/\delta^2\,; \quad . \quad . \quad . \quad (11)$$

showing dependence on the combined amount of solutes to be separated. In the second case, where the adsorption intensity is comparatively low, $\lambda = \delta / b_1 c_1^0$ and consequently, as $\lambda \gg 1$,

$$V = v^0 / \delta, \quad . \quad . \quad . \quad . \quad . \quad (12)$$

thus linking up with Wilson's equation[4] for non-developing bands.

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Anomalous Inactivation of Heavy Metal Antifouling Paints

THE inactivation of antifouling paints in th neighbourhood of an exposed steel surface, referre to by Young and Seagren[1], has often been encountere by investigators of the Marine Corrosion Sub-Committee. Fouling on one or both sides of an unpainte 'holiday' (the location of the fouling being determine by the direction of tidal flow) is invariably accompanied by rust deposits in the fouled areas.

The cause of this inactivation is probably no connected with the interaction of the base metal wit the heavy-metal poison; indeed the phenomeno has been observed by us in paints which rely largel or entirely on organic poisons. The following explanation, based on the work of Dr. U. R. Evans[2] o metallic corrosion in salt solutions, appears to offe a sounder basis for interpreting the observations.

At some portions of a bare steel surface exposed t sea water, the metal becomes anodic to the surrounding (in this case painted) area, and from the anodi regions ferrous ions pass into solution. These diffus outwards and in the presence of free oxygen and alkal arising from the cathodic reaction, form ferri hydroxide which becomes deposited as a rust coating In still water the ferric hydroxide is formed in th boundary region between the anodic and cathodi areas, but in the presence of a water current th deposition of rust will spread in the direction of th current.

The antifouling properties of the coating will b affected in several ways by this process. In presenc of the alkaline cathodic product, though the rosi matrix of the antifouling paint may be more rapidl dissolved, the solubility of the copper will be depressed in the presence of free OH′ ions. It has bee shown by extensive unpublished work in Grea Britain and in the United States[3] that for a coppe paint to be effectively antifouling, it must releas its copper at a clearly defined minimum rate into th sea water; if copper leaches out at a satisfactory rate under normal conditions, the effective toxicity of the paint will be greatly reduced in presence o alkali. The deposition of rust in the pores of the pain (which may be increased by cataphoretic action on the positively charged colloidal ferric hydroxide) wil also tend to reduce the loss of copper from the surface.

In the initial stages of their life, many antifouling paints show an excessively high rate of loss of copper —this is particularly true of metallic copper paints— and the early freedom from fouling in Young and Seagren's experiments is not at all surprising. The production of alkali in cathodic regions will only occur over the painted portion of the plate when the paint is sufficiently swollen after long soaking to be electrolytically conducting; alkali-softening of the paint, starting from the edge of the bare steel area, will spread outwards and progressively inactivate greater and greater areas of the painted surface.

There is thus no need to invoke the authors' hypothesis of inactivation by organic iron complexes; it is doubtful if the conditions are such as to encourage their formation. Dr. M. F. Spooner found that the pH of slime films in our experiments was never lower than 7·5; the rust on the paint surrounding a bare metal 'holiday' appears within a day or two even on synthetic resin paints, which form slime films only a few microns in thickness at this early stage. A similar type of rust deposit on painted steel panels occurs in sodium chloride solution in the laboratory;

nd the mechanism of inactivation suggested above ppears quite adequate to explain the effects observed.

The limited inactivation near an *insulated* steel lock is therefore due to the fact that the cathodic as well as anodic areas will be on the bare steel, so hat the above conditions for extensive deposition of rust on the adjacent paint surface do not exist; nd inactivation of the antifouling composition will be restricted to the painted area immediately adjacent o the edges of the insulated plate.

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Young and Seagren, *Nature*, 155, 715 (1945).

Evans, U. R., "Metallic Corrosion, Passivity and Protection", pp. 164 and 584 (London, 1938).

The following paper on work in the United States has arrived in Britain since going to press. Ketchum, B. H., Ferry, J. D., Redfield, A. C., and Burns, A. E., *Ind. Eng Chem.*, 37, 456 (1945).

Amino-quinazolines

IN a journal which has recently reached us, Dewar[1] reports the preparation of the 2-amino- and 4-amino-quinazolines. In the course of work on the amino-benzadiazines and their sulphanyl derivatives carried out in these laboratories, we had also prepared the amino-quinazolines, but in some respects our results differ from those described by Dewar. Thus we obtained good yields of 2-amino-quinazoline from guanidine nitrate and O-amino-benzaldehyde, a method stated by Dewar to yield only traces of the desired product. The 4-amino-quinazoline we prepared by amination of the corresponding chloro-compound.

Our melting points for the substances are somewhat higher than reported by Dewar, the 2-amino- and 4-amino-quinazolines having melting points of 204° and 272° respectively.

The bases were coupled with sulphonyl chloride to give 2-sulphanilyl-quinazoline (m.p. 286°) and 4-sulphanilyl-quinazoline (m.p. 255·5°), but the compounds are too insoluble to have chemotherapeutic activity.

Full experimental details of the work will be published elsewhere.

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[1] Dewar, *J. Chem. Soc.*, 615 (1944).

Influence of Sulphur Oxides on the Luminosity of Coal Gas Flames

IN the course of an investigation into the oxidation of sulphur dioxide in combustion reactions, forming part of a programme of work being carried out for the Boiler Availability Committee, some interesting observations have been made on the luminosity of coal-gas flames to which sulphur oxides had been added.

When sulphur dioxide was added in small quantities to a luminous smoky flame, the luminosity decreased and completely disappeared after about 5 per cent by volume of sulphur dioxide had been added. The flame showed a purple colour, and when a cooled funnel was held above the flame a yellowish-white deposit collected. Physical and chemical tests showed this to be sulphur. Spectroscopic examination of the flame revealed that a series of bands was present which appeared to be due to S_2 molecules. 5 per cent of sulphur dioxide added to a normally aerated bunsen flame shortened the outer cone and imparted a purple colour to this normally dark-blue region.

The addition of sulphur trioxide, on the other hand, increased the luminosity of coal-gas flames. When the port on the burner was adjusted so as to give an almost luminous flame, the introduction of 0·1–0·2 per cent by volume of sulphur trioxide brought about an immediate increase in luminosity. The same effect is observed in an aerated flame but the amount of trioxide required was of the order of 1 per cent. Whether this increased luminosity is due to emission from carbon particles produced by reactions involving the sulphur trioxide and the hydrocarbons present in the gas or to some other cause has not yet been established.

A detailed account of these results and of the behaviour of sulphur oxides in combustion reactions will be published shortly.

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Distribution of Vanadium, Chromium, Cobalt and Nickel in Eruptive Rocks

THE similarity, pointed out by P. H. Lundegårdh in a recent communication[1], between the amounts of the above trace elements in the normal series of igneous rocks from Eastern Upland, Sweden, and those in the corresponding members of the suite of rocks which we have analysed from the Skaergaard Intrusion, East Greenland[2], is of considerable interest in view of the differences between the two series of rocks. In describing our results, we offered tentative explanations of the observed variations in the trace constituents, based largely on V. M. Goldschmidt's earlier work, and we shall look forward to Lundegårdh's further treatment of the problem in view of his new data from Sweden.

In the meantime, it may be of interest to record some data, recently obtained, which indicate the actual location of the trace constituents in some of the minerals which make up certain of the Skaergaard rocks. From these data, we select the following for olivines and clino-pyroxenes separated from rocks previously analysed in bulk and quoted by Lundegårdh.

PERCENTAGE OF CERTAIN CONSTITUENTS IN OLIVINES AND CLINO-PYROXENES SEPARATED FROM ROCKS OF THE SKAERGAARD INTRUSION.

	Olivines from:		
	Gabbro picrite	Olivine gabbro	Hortonolite ferrogabbro
V	0·003	—	—
Cr	0·1	—	—
Co	0·01	0·01	0·01
Ni	0·1	0·04	0·001
Fe_2SiO_4	19	37	60

	Clino-pyroxenes from:		
	Olivine gabbro	Middle gabbro	Hortonolite ferrogabbro
V	0·01	0·01	0 003
Cr	0·04	—	—
Co	0·004	0·006	0 004
Ni	0·008	0·005	—
$FeSiO_3$	19	36	50

In the table a dash indicates that the amount present is less than the sensitivity of the spectrographic method employed, namely, vanadium 0·0005 per cent, chromium 0·0002 per cent, cobalt 0·0002 per cent, nickel 0·0002 per cent. The order in which the rocks are given is the order of their formation.

Plagioclase felspars have also been separated and other minerals are in the process of being separated and analysed.

The microscopic and field evidence indicates that the rocks selected for analysis represent, as closely as can be expected under natural conditions, crystal fractions from a single slowly cooling magma. The amounts of the trace constituents are in this case apparently controlled by the ease with which the trace elements enter the various crystal phases, and we must turn to the crystal chemist for a detailed consideration of the factors involved. The rocks of the Skaergaard Intrusion and the minerals composing them provide data on the kind of changes in the trace constituents which occur as a result of strong fractional crystallization differentiation of basic magma, and this should form a useful starting point in attempts to understand the variation in the trace constituents of rock suites having a more complex petrogenetic history.

Possible practical applications of results such as these include the diagnosis in soils, purely from a geological examination, of deficiencies or excesses, which may be of importance for problems of plant and animal nutrition.

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June, 1945

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[1] *Nature*, 155, 753 (1945).

[2] Wager and Mitchell, *Min. Mag.*, 26, 283 (1943).

Economy in Sampling

The method described by Haldane[1] for estimating the fraction p of a population having the attribute A is a particular instance of a more general theory which has been used in this department and elsewhere since 1943.

The statistical methods of assessing trial results in use before the War were for the most part developed in connexion with biological problems, where there is often present a limitation not found in other fields, namely, that the sample size for a proposed experiment must be determined in advance, before the experiment is actually begun. When such a limitation is unnecessary, it is found more efficient usually to plan a statistical *procedure*, and an associated test, for determining the question at issue.

For example, if we want to compare two designs, A and B, of an instrument, with regard to their comparative effectiveness, the classical procedure would suggest A be tried m times and B be tried n times, under similar conditions, and the numbers of successes observed for each design:

	1 Success	2 Failure	3 Total
Design A	a	c	m
Design B	b	d	n
Total	r	s	N

If we assume that, under the given conditions, A has a constant probability of success p_1 and B has constant probability of success p_2, then the null hypothesis $p_1 = p_2$ can be tested by a method which I have developed, or by a method due to Fisher[2], which, on the null hypothesis, associates with the above table a probability $m!n!r!s!/N!a!b!c!d!$. These tests correspond to the procedure in which column 3 of the table is fixed in advance, and columns 1 and 2 are filled in from the experimental results.

We may, however, be able to fix, say, column 2 in advance, and allow the experimental results to determine 1 and 3. In this case, by a procedure exactly analogous to Fisher's, we find that the probability on the null hypothesis associated with the above table is $(m - 1)!(n - 1)!r!s!/(N - 1)!a!b!(c-1)!(d - 1)!$, and we can construct a significance test accordingly. For large m and n there is a continuous approximation, which takes the form of the variance ratio function F, analogous to the χ^2 approximation in the classical case. There is also a correction for continuity, analogous to that of Yates[3].

In order to compare the efficiency of this test with that of the classical procedure, we have to compare at the mean sample size, since the actual sample size with the new procedure is not fixed. Consideration of the power for given mean sample size then shows that, when at least one of the two probabilities involved is small, the new test is much more powerful than the classical test. The power-ratio is not fixed, but for suitable values of p_1 and p_2 may increase without limit.

Similar considerations can be applied to all other kinds of statistical test. Broadly speaking, when the statistician was asked by the experimenter the question "How many items should I take for my sample?" it was often difficult to give a reasonable answer, since this would often depend on knowledge which could only become available after the result was known. By making sample size one of the variables which are determined in the course of the experiment itself, it is possible for the statistician to tell the experimenter: "If you follow this procedure, you will determine the issue involved just as soon as your results allow". From a passive role involving static planning and subsequent testing of results obtained, statistical theory acquires an active role, entering into the experimental process itself.

In developing tests for other situations, it is found that the statistical theory involved is closely connected, on one hand with the classical theory of games, as studied by de Moivre[4], Laplace and others, and on the other hand, with the theory of diffusion processes. In particular, the statistical tests involved in many consumer's inspection problems are direct generalizations of the classical problem of the "Ruine des Joueurs", in the qualitative case, while the continuous measurement case corresponds to a linear diffusion problem with fixed absorbent boundaries.

This work has been carried out as part of the programme of the Ministry of Supply.

G. A. Barnard.

Ministry of Supply,
Berkeley Court,
Glentworth Street, N.W.1.

May 11.

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[1] Haldane, J. B. S., *Nature*, 155, 49 (1945).

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IS HUMAN SPEECH GOOD ENOUGH?*

By SIR RICHARD PAGET, BART.

THE answer to the query in the title depends on what we mean by human speech—and what we ean by good enough!

Very few ideas can be directly expressed by sounds; und itself is not an essential of human speech—we n speak (to ourselves) and express meaning simply making the motions of 'articulation', without pro- cing any sound; deaf people who have learnt the t of lip-reading can understand such silent speech, watching the gestures of articulation. It is there- re the gestures rather than the sounds of speech hich carry meaning; the functions of sound, in eech, are to enable its meaning to be identified by ear.

The gestures of articulation are fundamentally ntomimic, and this pantomime is made audible by e vibration of our vocal cords—to produce 'voiced' unds; or by blowing air through our vocal cavities -to produce the 'unvoiced' speech sounds. The stures of articulation modify these voiced or un- iced sounds in much the same way as the manipula- on of the keys, slides, etc., of a musical wind strument modify its sounds; just as a skilled ombone player could, with his eyes shut, visualize e gestures of another trombone player by simply stening to his playing, so we, subconsciously, recog- ize a speaker's gestures of articulation by listening his speech. The voiced and unvoiced sounds of eech are the relics of the original emotional nguage of mankind.

The origin of mouth pantomime may be recognized the born deaf; they naturally express their ideas y bodily pantomime—mainly hand pantomime— hich they enrich with facial expression. Some form f emotional expression is essential if we are to succeed making our fellow men think as we want them to.

The combination of hand pantomime and emotional ounds eventually produced speech because of the arwinian "imitation or some kind of sympathy" etween the movements of man's hands and mouth Darwin, "The Expression of the Emotions" (1872), . 34). Alfred Russel Wallace, in an article in the *ortnightly Review* during 1895, wrote: "Speech was ormed and evolved . . . by men and women who elt the need of a mode of communication other than esture only. Gesture-language and word-language oubtless arose together, and for a long time were sed in conjunction and supplemented each other".

It follows that as primitive man pantomimed, his outh—without his knowledge—took part in the antomime; the result must have been a 'gabble' of peech-like sounds due to the changes of the volume nd size of orifice, and the constrictions and stoppages f the vocal cavities, and to the changes of the tone f voice caused by changes of emotional state.

In general pantomime, the sequence of gestures does not represent a succession of words—it describes ctions or states as a whole. This stage of general antomime, accompanied by mouth gabble, may have been man's normal mode of expression during the greater part of his million or half-million years of prehistoric development.

According to Prebendary Albert Smith, chaplain to the Royal Association in aid of the Deaf and Dumb, the uneducated born deaf still do not think in the same way as hearing people. They have no signs comparable to our words; their impressions are generalized (like their pantomime) and they cannot define anything, because they have no units with which to define. This is a point of the utmost importance. It distinguishes the career of primitive man from that of *Homo sapiens*, the analytical thinker of the last six or eight thousand years. At some point in his unrecorded history, man must have hit upon a new way of mentally handling his impressions; he separated them into categories, such as shape, colour, number, etc., and symbolized each separate element by a distinctive pantomimic sign. He could then begin to play with units of thought, transposing and recombining them in his mind, so as to arrive at new combinations and inventions.

This is admittedly hypothesis; but it offers a reasonable explanation of man's sudden and rapid advance in civilization. It was not man's brain which suddenly changed, but his way of using his brain.

The discovery, by primitive man, of the new method of analytic symbolism must have led, by slow degrees, to a new type of sign language composed of separate signs equivalent to modern words, performed in a more or less logical order, such as the Red Indian sign language.

The gesture theory of speech has recently received powerful support from Prof. Alexander Jóhannesson, of Reykjavik University, Iceland, who sent me a statement of which the following is a summary: In a twelve-years study of the Icelandic language (old and new) Prof. Jóhannesson examined every Indoeuropean root and found the etymology of about 20,000 words. It became gradually clear that a great many roots showed a primary meaning which was in accordance with the nature of the sound. In 1943 he published (in Finnish) his book "On the Primitive Language of the Indoeuropean People", in which he explained about 25 per cent of the whole Indoeuropean material and showed that a great part was due to imitation by the speaking organs of the movement of the hands. Having written about half of his book, my "Human Speech" came into his hands; he was delighted to see that, by studying the nature of the sounds, I had come to nearly the same results as he had by comparative philology. He was encouraged by my work and was now able to explain the majority of the Indoeuropean roots as gesture; he was highly satisfied to find the gesture theory confirmed also in Hebrew (in certain sound-groups he easily explained 60 per cent). He believes that my gesture theory will be of great importance for philology, and regards the problem of the birth of language in its chief principles as solved. Philology will take its place among the other sciences in the evolution of man. He is convinced that an international auxiliary language—which will be much needed in the near future—can only have a prospect of success if constructed in accordance with this new knowledge.

Here I must make one disclaimer: I did not originate the gesture theory; this was, I believe, originally propounded by Mr. J. Rae, of Honolulu, in three articles written, in 1882, for the *Polynesian* newspaper. Mr. Rae's work was referred to by Prof. Max Muller at a Royal Institution lecture on the science of language in 1863. His theory was not then described, but the British Museum had a bound volume of the *Polynesian* and the articles were reprinted as an appendix to my "Human Speech".

As to the question, "Is human speech good enough?", the answer, considering the appalling confusion into which this world has been thrown, largely by muddled thinking and perpetual misunderstandings, must surely be: No! We needed something more precise—more quantitative and less ambiguous—something which will advance human mentality as mathematics has advanced physical science and technology. The mystery and magic of human speech need no longer block the way. The late Prof. Otto Jespersen ("Mankind, Nation and Individual from the Linguistic Point of View", 1925) emphasized the duty of improving language for the sake of future generations, and said that "that language is best which, at every single point, is easiest to the greatest possible number of human beings".

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* Substance of Friday discourse at the Royal Institution, delivered on March 23.

English—though probably the best language yet evolved—is still very imperfect. Thus: 'to understand' does not mean 'to stand under'; 'to learn by heart' does not mean 'to learn by means of the heart'; 'to undertake' does not mean 'to take under'. As to changes of articulation in course of time, the so-called 'sound shifts' are mainly only 'exhibits' of the principle of 'least effort'. The organs of articulation tend to make their gestures easier to perform; voiced sounds become unvoiced, tongue postures are shifted to accommodate the accompanying consonant gesture, etc. Generally speaking, although 'least effort' is ever present, the significant gestures tend to be preserved, though the manner of making them may be modified.

As to verbal inflexions, English has discarded all the Germanic forms except that of the third person singular of its verbs—this hissing 'relic of barbarism' should be removed! Grammar itself is a relic of barbarism; it probably had its origin in sign language. Thus, it is easy to combine, say, the sign for 'come' with the finger signs for 1 or 2 or many, so as to sign one person come, two come, or many come. Mouth gesture cannot imitate these combined hand gestures; new arbitrary mouth gestures are substituted, and language becomes burdened with singular, dual and plural forms of its verbs.

Both English language and spelling need reform. Prof. Gilbert Murray, who is president of the Simplified Spelling Society, in a letter to me wrote: "I very much agree with you that English is so nearly a good language that it really ought to be looked after". If all children were taught something about the present *imperfections* of English, and were initially taught a rational system of spelling, reform would come of itself in another generation; if all children (throughout the world) were taught sign language—as a form of play—there would be one auxiliary international language available within the next twenty years. The British Commonwealth and the United States should join in appointing two English-speaking commissions, one to study the language, the other the spelling. Sufficient unification of pronunciation could easily be achieved through educational talking films and broadcasting.

The following are suggested as essential requirements: (1) Audibility. This implies that the unvoiced speech sounds should be eliminated, as being utterly inferior in audibility and in musical and emotional value. Also that accuracy of articulation should be considered as important as finger technique is in the playing of musical instruments. (2) Every word should be the result of a gesture of articulation which is pantomimically related to the meaning of the word. (3) Every word should be invariable in its form, and capable of use as any part of speech—as in Chinese. (4) Every root word should be monosyllabic. (5) The word order should be strictl logical—it is absurd to invert the word order t denote a question (as in English). (6) Homophone should be eliminated. (7) The spelling should b systematic—with a separate alphabetical symbol fo each separate sound.

The development of an international auxiliar language on these principles has been carried near t completion by Mr. Kenneth Littlewood. It is name 'Monling', and was expected to be ready for th printer shortly. The sentence "The best language that which is easiest to learn and use" becomes, i 'Monling', "Ling 't top pai ken ad ploi il klar to bon"—where ' represents the English indefinit vowel, like the 'e' in "the king" or the 'a' in sofa

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CHEMOTHERAPY OF TUBERCULOSIS

By Dr. M. A. SOLTYS

University of Cambridge

SINCE Ehrlich's discovery of 'Salvarsan' there hav been several attempts to seek a chemotherapeuti drug for the treatment of many infectious disease Of all the chemical substances studied in the chemotherapy of tuberculosis, calcium and gold compound have probably attracted more attention over a longe period of time than any others. Maver and Wells from their intensive investigations, came to th conclusion that calcium does not support the conception of a favourable influence on the course o tuberculous infection, nor does it appreciably increas the calcium content of blood and tissue, and n specific significance has been proved as yet fo calcium and its combinations.

Concerning gold therapy, Møllgaard in 1924 presented 'Sanocrysin' ($Au(S_2O_3)_2Na_3$) as a *magn sterilisans* in tuberculosis on the basis of anima experiments. He claimed that 'Sanocrysin' in th blood stream causes lysis and kills the bacilli. Afterwards that substance and several other gold compounds were studied by many workers, who claim that gold exerts no direct bactericidal action on th tubercule bacillus, but that it increases the resistanc through the reticulo-endothelial cells. According t them, gold appears to have found its place as reinforcing stimulant in the therapy of tuberculosis especially in cases in which collapse therapy is fo some reason or other impossible.

The year 1935 brought a great change in bacteria chemotherapy by the discovery of sulpha drugs After the first reports of Rich and Follis[2] on th inhibitory effect of sulphanilamide in experimenta tuberculosis of guinea pigs, two opposing opinion developed concerning this effect: first, that of the group of investigators who used exactly the sam technique as Rich and Follis and obtained simila results, especially with sulphanilamide and sulphapyridine; secondly, that of the group of investigator who chose other routes of administration and als different sulphonamide derivatives; but the drug tested were comparatively ineffective.

Striking results have been attained by Feldman an Hinshaw[3] and their co-workers in experimental tuberculosis of guinea pigs treated with the new diaminodiphenylsulphone compound 'Promin'. 'Promin', i its solid form, varies from white to light yellow an slightly hygroscopic. It is highly soluble in water, nd 40 per cent solutions are stable indefinitely and an be sterilized by heat. It is slightly bitter, but nall amounts may be mixed with the food of nimals without impairing their appetite or digestion. he guinea pigs tolerate a daily dosage by mouth of 00–400 mgm. over long periods. The experiments ndicated that in many of the animals 'Promin' either ad prevented the establishment of lesions or had aused their eventual disappearance. In the vast majority of the animals in the treated group that ad lesions, the histopathological characteristics of he disease process apparently were modified favourbly. The failure to demonstrate lesions of tuberulosis in a considerable number of the animals that vere treated, and the further fact that the disease in he treated animals was with few exceptions minimal nd non-progressive, indicate that the action of the rug was significant. Encouraged by the animal xperiments, 'Promin' has been used in the treatment of a few cases of tuberculosis in human beings. In nan, unfortunately, much lower dosage relative to veight may soon produce toxic effects, particularly æmolytic anæmia. In these few cases treated with Promin', it appeared, that outstanding success has not been attained in man with any dosage which is vell tolerated. In Great Britain, Tytler and Lapp[4] pplied 'Promin' locally to superficial tuberculosis esions in ten cases. The improvement in all cases was greater, or more rapid, than would have been expected by orthodox methods of treatment. These authors reported that Dr. G. T. Allerton, of Torquay, had been applying the drug to superficial lesions with much success.

In 1943, Kharash and Reinmuth reported on a derivative of N-(1-carboxyacylaminoethylthiomethyl) designated as 'Kharash 1048'. This substance had shown an inhibitor effect on the development of experimental tuberculosis in guinea pigs (Hinshaw and Feldman[5]). More recently, Petter and Prenzlau[6] have described their results with diazone (the disodium formaldehyde sulpho oxylate derivative of 4-4″ diaminodiphenylsulphone, a compound synthesized by Raiziss) in forty-four patients. All the patients received diazone for 120 days or more. The total daily dose was 1 gm. There appear to have been no serious reactions except some cyanosis and nausea in about one quarter of the patients. Signs of improvement were first noticed between the 45th and 125th days of treatment. In 60 per cent of the group, sputum became negative. The authors consider they observed marked improvement in 18 per cent and moderate improvement in 50 per cent of cases.

Thus 'Promin', diazone and other related compounds appear to possess in varying degree the striking power of restraining the development of experimental tuberculosis in guinea pigs; but it is recognized that experimentally induced tuberculosis in guinea pigs offers many contrasts with clinical tuberculosis in human beings, even though the causative organism is the same. Despite the lack of convincing evidence of the value of present chemotherapeutic substances in the treatment of human tuberculosis, further controlled clinical investigation is clearly desirable.

No review of progress in this sphere would be complete without reference to the observations made on antibiotic substances produced by micro-organisms such as penicillin, gramicidin, etc. The treatment with antagonistic organisms was initiated by Cantani (1885), who employed, with reportedly favourable results, an organism designated as 'Bacterium Termo'. Later, many papers on that subject were published announcing varying degrees of success. Recently, two papers appeared on the subject, one by the present writer[7], who obtained promising results *in vitro* with filtrate of culture of *Aspergillus Fumigatus* No. 367 N.C.T.C., grown on modified Czapek Dox medium, and a second published by Miller and Rekate[8], who found that the growth of a strain of the tubercle bacillus was inhibited by a green mould of the penicillin group which accidentally grew on a culture of the tubercle bacillus stored in an icebox. The negative effect of penicillin upon *Mycobacterium tuberculosis* has been reported by Sir Howard Florey and his school[9].

All possibilities for the treatment of the disease should be explored at the present time, when the number of clinical cases of tuberculosis is increasing daily in starving Europe. Even in Great Britain, where conditions of living are fairly good, Stocks[10] considers that for all forms of tuberculosis the cost of the War up to mid-1942 may be estimated at about 11,000 deaths. Research on the control and treatment of tuberculosis should be regarded as a matter of urgency at the present time, and it is difficult to understand why there has been no foundation of a separate institute for the study of tuberculosis.

However, as research continues and newer compounds are made available, what were perhaps previously considered to be futile efforts now assume a new importance and provide a measure of hope for believing that an effective chemotherapeutic agent will be eventually found.

[1] *Amer. Rev. Tuberc.*, 7, 1 (1923).
[2] *Bull. Johns Hopkins Hosp.*, 62, 77 (1938).
[3] *Amer. Rev. Tuberc.*, 41, 732 (1940).
[4] *Brit. Med. J.*, 2, 750 (1942).
[5] *Amer. Rev. Tuberc.*, 50, 202 (1944).
[6] *Amer. Rev. Tuberc.*, 49, 308 (1944).
[7] *Nature*, 154, 550 (1944).
[8] *Science*, 100, 172 (1944).
[9] Abraham *et al.*, *Lancet*, 251, 171 (1941).
[10] *Brit. Med. J.*, 2, 750 (1942).

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES

ANNUAL CONGRESS, 1945

THE fiftieth annual congress of the Union was held at Harpenden on July 7 at the invitation of the director of Rothamsted Experimental Station and by arrangement with the Harpenden Urban District Council. Before the presidential address was given the following sectional addresses were delivered: "Church Chests", by Edward Yates; "Trace Elements", by Dr. Winifred E. Brenchley; "Some New Weapons in the Geological Armoury", by P. Evans; "Country Planning", by C. S. Orwin; and "Fishing Research and the Overfishing Problem", by Dr. E. S. Russell.

Before the official business of the Union was transacted, Miss E. C. Busby, chairman of the Urban District Council, welcomed the congress. The new president, Dr. W. G. Ogg, director of Rothamsted Experimental Station, was then installed and gave an address entitled "Some Aspects of the Work at Rothamsted". Brigadier F. A. E. Crew presided. The presidential and sectional addresses will be published in full in Vol. 50, 1945, of the *South-Eastern Naturalist and Antiquary*.

Dr. Ogg mentioned that the Rothamsted work can be divided into two broad sections, one on soils and plant nutrition and the other on plant pathology and insect pests. Field experiments still occupy a prominent place in the programme. An important but little-known branch of this work is formed by the experiments conducted on farmers' own land in various parts of Britain; these provide information about the efficiency of fertilizers over a wide range of soil types and climatic conditions. Although field experimentation of this kind is done extensively in certain other countries, much of it is not above the 'demonstration' level. The number of the Rothamsted 'outside' experiments, the length of time they have been in progress and the fact that modern statistical technique is used, make them a unique series.

Modern experimental technique in conjunction with tests of the validity and significance of results was developed at Rothamsted as a corpus of knowledge by Prof. R. A. Fisher. It is used in all laboratory and field work at Rothamsted, and though barely twenty years old is standard in agricultural experimentation throughout the Empire, and is being increasingly adopted by progressive countries elsewhere. Efficient sampling surveys are a recent development of this technique and have been applied to various war-time activities, notably the formulation of a fertilizer policy. Philosophically, the new technique is of interest because it enables several factors to be examined simultaneously; as Fisher pointed out, if Nature were asked only one question she would often refuse to answer until some other topic was discussed.

A broad base is characteristic of the Rothamsted work; for example, biology cannot be excluded even from the study of soil physics. The availability of soil moisture for plants is bound up with organic manuring, including the use of leys; and cultivation cannot be studied without reference to roots. Fundamental work has been done at Rothamsted on the relation of the nodule bacteria to their host plants, and, with an increased staff, microbiological studies are being extended to include mycorrhiza and other problems having a community interest in more senses than one. From their very nature, the botanical studies on weeds in arable and grass-land have long had this interest.

The pathological studies include the intricate relationships between viruses and their insect vectors, and the not less obscure problems of the relation between husbandry and fungal diseases. The population aspect of insect behaviour has been a feature of the entomological work. The study of pest outbreaks is regarded as an appreciation of the changes in insect numbers in a locality. A distributional outlook has recently been brought to bear on problems of slugs and earthworms.

Collaboration between chemist and biologist in the department dealing with insecticides has brought about some remarkable achievements, including the establishment of an 'insect zoo', by means of which healthy insects for testing purposes are on hand the greater part of the year. In conclusion, Dr. Ogg said he would like to mention his hopes for the Department of Pedology now being formed. Soil classification is still in its infancy; in particular, the understanding of tropical soils is far from satisfactory. In the new department attention will be given to Colonial as well as to domestic soils. In this department, as in others, while preserving the best in the old must have an adventurous outlook on the new.

In July 1946 the Union hopes to hold its jubil congress of three or five days at Tunbridge Wells, t president-elect being Dr. Lancelot Hogben.

CARNEGIE CORPORATION OF NEW YORK

THE annual report of the Carnegie Corporati of New York for 1944 includes the report of t president, W. A. Jessup, prepared before his dea on July 9, 1944, and the report of the secretary a of the treasurer. The report of the president for t year ending September 30, 1944, compares the wor of the Corporation and the college thirty years ag and now, and stresses the extent to which America colleges and universities have, with their responsibilit for large endowments, found themselves engage indirectly or directly in many forms of business the ownership and control by the University Chicago of the "Encyclopædia Britannica" and the educational films of Eastman Kodak Co. an Electrical Research Products Inc. being an exampl One leading mid-western university has reporte contracts with Government agencies alone which in volve the expenditure of more money than the university proper has ever before expended in a single yea

The U.S. Government, through its Office of Scientific Research and Development, is currently expending more than 125,000,000 dollars in researc carried on chiefly by university scientific men. I recent years it has been a common practice for business and industrial organizations to unite in establishing foundations to enable them to work mor effectively with the colleges and universities. A distinctive feature of these relations of the college and the university to the public is the fact that Government, industry, private donors and foundations tend to specify the purpose for which the money is to be expended. This tendency to delimit the use of money is so common that only the exceptional college president or trustee can discuss the future of his institution in terms other than those of itemized additions to its programme. The combined endowments of colleges and universities to-day, as reported to the U.S.A. Office of Education, are more than 1,686,000,000 dollars, as compared with the 166,000,000 dollars at the turn of the century. At the present time the income of the Carnegie Corporation is about 4,500,000 dollars, while the receipts of American colleges in 1940 exceeded 630,000,000 dollars. Comparatively, the educational importance of the Corporation, as expressed in income and assets, is thus less than a generation ago. The reduction in income of the Corporation and the consequent reduction in grants made places a heavy burden on the trustees in appropriating the available income, and an examination of the list of appropriations during 1930–32 shows many grants for purposes which are no longer largely aided by the Corporation.

The report of the secretary contains a complete list of appropriations voted during the year 1944 totalling 5,873,215 dollars, the largest single grant being 5,000,000 dollars to increase the endowment of the Carnegie Institution of Washington, making that Institution the most heavily endowed scientific research agency in the United States, if not in the world. Its total endowment is now some 32,000,000 ollars. In addition to grants to various national mergency organizations, the Corporation voted 5,000 dollars to the Carnegie Endowment for International Peace for its educational work in the United tates, 40,000 dollars to the Council of Foreign Relations for its research and publication programme nd programme of regional committees, 34,000 ollars to the Institute of Pacific Relations and 0,000 dollars to the Foreign Policy Association.

The most ambitious single Corporation project oncerning the Negro has been the comprehensive tudy of the Negro in America conducted by a staff f research specialists directed by Dr. Gunnar Myrdal, which was published in two volumes in anuary 1944 under the title "An American Dilemma: The Negro Problem and Modern Democracy". The Corporation is endeavouring to regain and maintain lexibility of action from year to year in regard to he use of annual income, and the trustees are studying carefully what particular interests in the crucial imes to come may best constitute an effective programme for the Corporation. The report of the ecretary also includes a list of useful publications with the issue of which the Corporation has been oncerned.

THE COD

An important and detailed account of the biology and economy of the cod in the Newfoundland area has now become available*, based mainly on tagging experiments during 1931–35, both in inshore and in deep waters. The fishing industry in these regions has tended to lag behind those of other countries, not on account of lack of fish but because of the geographical position of Newfoundland, its small population and the absence of international trading facilities. With Norway and Iceland it is one of the three great centres of cod stocks, and it has also many other valuable fish.

The vast area of Grand Bank is the outstanding important portion of the Newfoundland area and is the key area for study. It should probably be regarded as containing the parent cod stocks with which many subsidiary stocks, including those found inshore, must be correlated. The study of the inshore cod should therefore on no account be separated from that of the cod on the banks, especially Grand Bank, and the deep-sea fishing should certainly be increased and not reduced, as the reservoir of fishes is on the banks. It is essential that both the inshore and bank fisheries should be intensively developed.

Reference for comparison is made to previous tagging experiments in the north-western Atlantic, Greenland and Iceland, the Faröe Channel and the north-eastern Atlantic. From these it appears that the cod (especially young cod) are comparatively circumscribed in their movements, the larger proportion of recaptures being made in or near the point of tagging. A few carry on extended migrations, and for spawning purposes there can be what amounts to mass migration from one region to another, the migration being necessary probably where good feeding and spawning conditions do not occur in the same region. The evidence supports the general hypothesis of the existence of local races of cod, most of which, in any event in the early years of life, remain within a region where a specific range of hydrographic and feeding conditions prevails, and in these there are characteristic and recognizable biological features, such as average number of vertebræ, rate of growth and fluctuations in good, moderate and poor years of hatching and survival of fry.

With regard to the Newfoundland tagging experiments, the main object of which was to obtain direct evidence of migrations, it was found that those tagged on the banks were much larger than those tagged elsewhere, the latter being mostly immature fish; 91·2 per cent of the inshore cod tagged were recaptured locally within 100 miles (and more than half of these within 10 miles), and only 8·8 per cent travelled distances of upwards of 100 miles. Only 1·5 per cent travelled more than 250 miles, a distance which might or might not take the cod into a zone of markedly different hydrographical conditions. With the bank cod the results were somewhat similar, but only 68·9 per cent were recaptured within 100 miles, and 31·1 per cent carried out migrations of more than 100 miles. Only 6·8 per cent exceeded 250 miles. Thus the bank cod carried on rather more extensive migrations than those from the inshore.

The fish up to about three years old are practically stationary, and up to the age of six or seven years, or even more, the average movement from the location would probably not exceed 200 miles. Thus there is every reason to believe that races of cod can occur. After maturity is reached, there appear to be increased migrations and intermingling. The maximum distance travelled by any recaptured cod was 560 miles, from Fortune, in the south of Newfoundland, to White Bay, in the north-east.

From the analysis of results of counts of vertebræ, and of first-year circuli in the fish scale, it is possible to recognize two main stocks: those growing to maturity in cold water (arctic type) and those in warmer ocean water (bank type) respectively. Mixing of these also takes place to a certain extent. The parent stock is probably that of the Grand Bank.

The majority of Newfoundland cod attain first maturity between the sixth and ninth year of life, at a size of 60–80 cm. In this they resemble Iceland and Norwegian cod rather than those from the North Sea, where maturity occurs at an earlier age than the above. Most spawning occurs in spring, but the season may extend from March to October. It is later in the north than in the south. The distribution of eggs and fry varies according to the type of season—whether or not the arctic current is of normal, or of greater or less than normal strength. Eggs and fry occur chiefly off the east coast of Labrador and Newfoundland and on the banks, the centre of density of distribution being rather more northerly in warmer years, and more southerly in colder years.

The fishery in general is most successful in colder rather than warmer years, although cod in more southerly regions are conditioned to water of higher temperatures than are cod of more northerly regions. In the latter, large catches are made in water of temperature 0° C. and even lower. The optimum temperature for large catches varies according to the region. It would be of advantage if information on prevailing and probable temperature conditions were made available to fishermen.

There is no sign of overfishing on the Grand Bank, which is probably capable of producing a higher yield. It is through the moderate development of trawling that progress is likely to be made.

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* Newfoundland Gov. Research Bull. No. 14: A Biological and Economic Study of the Cod (*Gadus callarias* L.) in the Newfoundland Area including Labrador. By Dr. Harold Thompson. Pp. 160. (St. John's: Department of Natural Resources, 1943.)

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Engineer and Manager of the Warrington Water Undertaking—The Town Clerk, Town Hall, Warrington (endorsed 'Water Engineer and Manager') (August 24)

Senior Engineers (capable of designing high or low pressure water turbines, governors, or hydraulic valves) for work in the Midlands—The Ministry of Labour and National Service, Appointments Department. Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting D.1139.X (August 24).

Civil Engineering Assistant, and Junior Engineering Assistants (3, temporary)—The Clerk to the River Ouse Catchment Board, 7 Landcliffe Avenue, Harrogate (August 25).

Deputy Chief Drainage and Water Supplies Officer—The Executive Officer, Cheshire War Agricultural Executive Committee, Reaseheath, Nantwich (August 25)

Speech Therapist to the West Ham Education Committee—The Education Officer, Education Offices, 95 The Grove, Stratford, London, E.15 (August 25).

Research Assistant and Demonstrator in Zoology—The Acting Registrar, The University Leeds (August 25)

Lecturer in Botany—The Registrar, The University, Manchester, 13 (August 25).

Advisory Bacteriologist for the East Midland Province—The Principal, Midland Agricultural College, Sutton Bonington, Loughborough (August 25).

Technical Assistant in the Borough Engineer's Department—The Borough Engineer and Surveyor, Hornsey Town Hall, Crouch End, Broadway, London, N 8, endorsed 'Technical Assistant' (August 27)

Assistant Lecturer (temporary) in Geography—The Registrar, University College, Singleton Park, Swansea (August 28)

Head of the Technological and Science Department of the Wakefield Technical College—The Director of Education, Education Department, 27 King Street, Wakefield (August 29).

Librarian, at the College in Trinidad—The Secretary Imperial College of Tropical Agriculture, Grand Buildings, Trafalgar Square, London, W.C 2 (August 31).

Mechanical Engineers for oil refineries (Ref No. C 2587.XA), Senior Research Engineers (Ref. No C.2022.XA), and Senior Mechanical Engineers for direction of work on the application of fuels and lubricants to i/c and other engines, and to various types of industrial work (Ref. No C 2667 XA), for home and overseas service with a large industrial organization—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting the appropriate Reference No. (August 31).

Gas Engineer and Manager—The Town Clerk, Town Hall, Southport, endorsed 'Gas Engineer and Manager' (August 31).

Strathcona-Fordyce Chair of Agriculture—The Secretary, The University, Aberdeen (August 31).

Psychologist (full-time)—The Chief Education Officer, County Hall, Taunton (September 1)

Psychiatric Social Workers (2, full-time, women) for Ealing and Harrow—The Clerk to the County Council, Middlesex Guildhall, Westminster, London, S.W.1 (September 1)

Lecturer in Physics—The Registrar, King's College, Newcastle-upon-Tyne (September 3).

Principal or Superintending Metallurgist with headquarters in London, a Senior or Principal Scientific Officer (preferably a physical chemist) for refractories, moulding sands, slags, etc., a Senior or Principal Scientific Officer (preferably a physicist) for instruments and automatic control in all fields of the Iron and Steel industry; and other posts of a more junior category for Chemists Physicists, Engineers and Metallurgists—The Secretary, British Iron and Steel Research Association, Steel House, Tothill Street, London, S.W.1 (September 7)

Probationary Assistant Lecturer in Physics, a Probationary Assistant Lecturer in Chemistry, and a Probationary Assistant Lecturer in Zoology—The Bursar and Acting Registrar, University College of North Wales, Bangor (September 10)

Probationary Assistant Lecturer in Agricultural Botany—The Bursar and Acting Registrar, University College of North Wales, Bangor (September 10).

Civil Engineer or Public Works Contractor's Agent to take control of an area in connexion with the employment of German P o.W. labour on construction of roads and sewers (Ref. No. E.1645 A), an Assistant Civil Engineer or Architect A.M I C.E or A.M.I.M and Cy.E or A.R.I.B.A., or equivalent, to act as assistant to the above (Ref. No. E.1735.A), and a Civil Engineering (Structural) Assistant (Ref. No. E.1462.A)—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W C 2, quoting the appropriate Reference No. (September 14).

Academic Registrar—The Principal, University of London, Richmond College, Richmond, Surrey (September 15).

Chief Assistant (male) at the Government Archives, Salisbury, Southern Rhodesia—The Official Secretary to the High Commissioner, Rhodesia House, 429 Strand, London, W.C.2 (September 17).

Lecturer in Natural Philosophy at University College, Dundee—The Secretary, The University, St. Andrews (October 1).

University Chair of Anatomy, tenable at St. Bartholomew's Hospital Medical College—The Academic Registrar, University of London, Richmond College, Richmond, Surrey (October 31)

Lecturer in Applied Mathematics within the Department of Natural Philosophy—The Secretary, The University, Aberdeen

Lens Workshop Instructor (full-time)—The Principal, Northampton Polytechnic, St. John Street, London, E.C.1.

Superintendent of Applied Research—The Secretary, British Rubber Producers' Research Association, 19 Fenchurch Street, London, E.C.3.

Chair of Naval Architecture in the Faculty of Engineering of the Technical University, Istanbul—The Appointments Department, British Council, 3 Hanover Street, London, W.1.

Biology Master to teach the Zoology of the Science Sixth Fo to Open Scholarship standard and General Biology throughout School—The Headmaster, Blundell's School, Tiverton, Devon

Assistant to Chief Chemist—The Establishment Officer, M Marketing Board, Thames Ditton, Surrey.

Technical Assistant to the Advisory Bacteriologist, in co nexion with the National Milk Testing and Advisory Scheme. Southe Province—The Advisory Dairy Bacteriologist, National Institute Research in Dairying, Shinfield, Reading.

Lecturer (full-time) in the Applied Chemistry Department The Secretary, Northampton Polytechnic, St. John Street, Londo E.C.1.

Psychologists (part-time) for Child Guidance Clinics—The Cha man, Child Guidance Committee, County Hall, Chichester.

Lecturer in Engineering (subjects. Practical Mathematics a Engineering Science up to Ordinary National Certificate standard) The Principal, Day Continuation and Technical Schools, Falmout

Assistant (temporary, full-time) with First or Second Class Honou or Higher Degree in Mathematics, at the Bridgend Mining and Technic Institute and Technical School—The Director of Education, Coun Hall, Cardiff.

Teacher for Engineering Subjects, chiefly in the Day Juni Technical School—The Principal and Secretary, Harris Institut Preston

Lecturer (man or woman) in Mathematics and Physics at t Dudley Training College—The Secretary to the College Council, Educ tion Offices, St James's Road, Dudley.

Senior Mathematics Mistress to organize the subj throughout the School to University Entrance standard and Assistant Mistress to teach Physics or Biology, and Mathemati—The Headmistress, The Abbey, Malvern Wells, Worcs.

REPORTS and other PUBLICATION

(not included in the monthly Books Supplement)

Great Britain and Ireland

Bath and West and Southern Counties Society. Pamphlet No. 13 Fertilizers during the War and After. By Dr. E. M. Crowther. P xiv+54. (Bath: Bath and West and Southern Counties Societ 1945.) 2s. [1

The New Education Act: a Talk to Parents. Pp. 8. (London National Union of Teachers, 1945.) Free [20

University of London. Report of the Principal on the Work of th University during the Year 1944–45. Pp. 8. (London: Universit of London, 1945.) [20

Other Countries

National Research Council of Canada. The Distribution of Thunde storms and the Frequency of Lightning Flashes: a Review. By R Ruedy. (N.R.C. No 1282.) Second edition, revised and enlarge Pp. 70+5 plates. (Ottawa: National Research Council of Canad 1945.) 1 dollar. [2

Indian Central Jute Committee. Technological Research Memo No. 6. The Relations between the Chemical Fibre Characters an the Spinning Quality of Jute. By P. B. Sarkar, S. B. Bandyopadhya and C. R. Nodder. Pp. 16. (Calcutta: Indian Central Jute Committee 1944.) 12 rupees; 1s. [2

Imperial College of Tropical Agriculture. Report of the Governin Body and the Principal's Report to December 31st, 1944, and th Accounts for the Year ended August 31st, 1944. Pp. 28. (Trinida and London: Imperial College of Tropical Agriculture, 1945.) [3

Tata Memorial Hospital for the Treatment of Cancer and Allie Diseases. First Triennial Report, 1941–1943. Pp. vi+36. (Bombay Tata Memorial Hospital, 1945.) [3

Indian Forest Leaflet. No. 66: Indian Woods for Pencil Making By M. A. Rehman and S. M. Ishaq. Pp. ii+8. (Dehra Dun: Fores Research Institute, 1945.) 4 annas. [3

Indian Forest Records (New Series). Utilization, Vol. 3, No. 6 The Identification of Burma Commercial Timbers. By Dr. K. Ahma Chowdhury. Pp. iii+27+15 plates. (Dehra Dun: Forest Researc Institute, 1945.) 12 annas. [3

Survey of India. Geodetic Report, 1940. Pp. iv+34+9 charts (Dehra Dun: Survey of India, 1945.) 2 rupees; 3s. [3

Zoological Society of Egypt. Supplement to Bulletin No. 7: A Collection of Birds from Western Saudi-Arabia, January to June 1944 By Shamseddin Halfawi. Pp. 12. (Cairo: Zoological Society of Egypt 1945.) [4

Parliament of the Commonwealth of Australia. Eighteenth Annua Report of the Council for Scientific and Industrial Research, for the Year ended 30th June 1944. Pp. 78. (Canberra: Government Printer, 1945.) 3s. 4d. [5

Report and Accounts of the National Botanic Gardens of Sout Africa, Kirstenbosch, Newlands, Cape (and the Karoo Garden, Whitehill, near Matjesfontein) for the Year ending 31st December 1944. Pp. 14. (Kirstenbosch: National Botanic Gardens, 1945.) [9

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Geological Survey of British Guiana. Bulletin No. 20: Report on Exploration for Oil in British Guiana. By H. G. Kugler, S. C. Mackenzie, R. M. Stainforth, J. C. Griffiths and G. R. Brotherhood. Pp. 78+6 plates. (Georgetown: Government Printers, 1944.) 1 dollar. [177

League of Nations. Fiscal Committee. Model Bilateral Conventions for the Prevention of International Double Taxation and Fisca Evasion. Second Regional Tax Conference, Mexico, D.F., July 1943. (Official No.: C.2.M.2.1945.II.A.) Pp. 88. (Geneva: League of Nations; London: George Allen and Unwin, Ltd., 1945.) 3s. 6d. [177

South Australia: Department of Mines, Geological Survey of South Australia. Bulletin No. 22: The Search for Oil in South Australia. By Dr. L. Keith Ward. Pp. 40. (Adelaide: Government Printer, 1944.) [177

NATURE

No. 3956 SATURDAY, AUGUST 25, 1945 Vol. 156

CONTENTS

Page
eedom of Scientific Intercourse 215
ethod in Metaphysics. By Prof. L. J. Russell . 217
e Posthumous Testimony of an Anthropologist. By Dr. C. S. Myers, C.B.E., F.R.S. 218
Naturalist of the Highlands. By Dr. F. Fraser Darling 219
od Science. By Dr. T. Moran 220
ademy of Sciences of the U.S.S.R. . . . 221
ence in the U.S.S.R.
  Physiology. By Prof. E. D. Adrian, O.M., F.R.S. . 222
  Contemporary Physics. By Prof. E. N. da C. Andrade, F.R.S. 223
  Archæology and Anthropology. By Prof. V. Gordon Childe 224
  Vertebrate Palæontology. By Prof. D. M. S. Watson, F.R.S. 225
  Medicine. By Prof. Arnold Sorsby . . . 226
  Agrochemistry. By Dr. E. M. Crowther . 227
bituaries:
  Major C. E. S. Phillips, O.B.E. By R. S. Whipple . . 228
  Mr. R. W. F. Harrison and Mr. A. G. Hastings White, C.B.E. By Sir Henry Dale, O.M., G.B.E., F.R.S. . . . 228
ews and Views 230
etters to the Editors:
  Further Observations on the 'Incomplete' or 'Blocking' *Rh* Antibody.—R. R. A. Coombs and R. R. Race . . 233
  Heterogeneity of Human Serum Albumin.—H. Hoch and C. J. O. R. Morris 234
  An Antibiotic Substance in the Chinese Water-chestnut, *Eleocharis tuberosa*.—S. L. Chen, B. L. Cheng, W. K. Cheng and P. S. Tang 234
  Utilization of Carotene from Oils.—S. Dattatreya Rao . 234
  Control of Internal Boll Rot of the Cotton Plant, caused by Insect Punctures (*Dysdercus* sp.), through Selection of Resistant Strains.—Prof. Teodoro Boza Barducci, Prof. Germán García Ráda and Prof. Johannes Wille . . 235
  Inheritance and Acquired Characteristics.—Prof. Wm. Rowan 236
  A British Freshwater Nemertine.—Rachel B. Braithwaite and Evelyn B. Clayton 237
  The Popliteal Facet in Men who Habitually Squat.—Prof. M. A. Shah 238
  Effect of High Vitamin A in the Diet of Domestic and Non-domestic Animals.—Hilda H. Wheeler . . . 238
  Spontaneous Regression of Histological Malignant Tumours Induced in Rabbits by 9.10-Dimethyl-1:2-Benzanthracene —Stephan Beck 238
  Phase Transitions in Condensed Monolayers of Normal Chain Carboxylic Acids.—Stina Ställberg-Stenhagen and Einar Stenhagen 239
  Infra-Red Spectra of Coals.—C. G. Cannon and Dr. G. B. B. M. Sutherland, F.R.S. 240
  Effect of Temperature on Magnetic Susceptibility of Molybdenite Crystals.—Ajit Kumar Dutta 240
  Viscosity of Ordinary Liquids at High Rates of Shear.—L. Grunberg and Dr. A. H. Nissan 241
  Visible Glow Discharge at very, Low Potentials.—Dr. A. Sommer 242
  Mechanism of the Beckmann Rearrangement.—Flight-Lieut. Bryan Higman 242
Some French and German Geographical and Geological Institutions. By Dr. John W. Wells 243
Uses and Limitations of Penicillin. By Dr. G. Lapage 244
Plant Studies in Syria 246
Mass Movement of the Water Shrew, *Neomys fodiens*. By Frances Pitt 247
Serum Proteins in the Ultracentrifuge. By J. St. L. Philpot 247
Recent Scientific and Technical Books . . Supp. ii

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FREEDOM OF SCIENTIFIC INTERCOURSE

SPECULATIONS as to the implications for material progress no less than for destructive purposes of the immense co-operative scientific effort that went to the evolution of the atomic bomb may tend to distract attention from some important issues relating to the progress of science itself. The profound secrecy in which this effort has been enveloped should emphasize the fact that for some six years the normal channels of communication between scientific men have been interrupted, and to restore such intercourse across national frontiers is the first step to stimulate the creative thought and exchange of knowledge and ideas upon which the progress of science finally depends. Sir Henry Dale has been prompt to point out, in a letter in *The Times*, that the preservation of civilization itself may now well depend on the fullest freedom of scientific intercourse. The abandonment of any national claim to secrecy about scientific discoveries, he suggests, must be a pre-requisite for any kind of international control such as will be indispensable if we are to use atomic energy to its full value and avoid the final disaster which its misuse might bring.

There may be no immediate opportunity for a national, still less for an international, exchange of scientific opinion, but the magnificent loyalty with which scientific workers have kept this greatest of war secrets cannot disguise the fact that those concerned, and their colleagues in science everywhere, are increasingly impatient for the revival of the world community of science to which Sir Henry referred. The importance of removing the restrictions on the scientists' liberty "to know, to utter, and to argue freely according to conscience" has already been stressed in the discussions on the development of scientific and industrial research in Britain, and has been emphatically endorsed in the report which Dr. Vannebar Bush recently presented to President Truman under the title "Science: the Endless Frontier". That report showed unmistakably that authoritative scientific opinion in the United States has come to recognize the need for more official methods of carrying on international scientific activity. Not merely the removal of war-time restrictions and hindrances, but also the positive encouragement of the exchange of knowledge and ideas by means of international scientific congresses, international fellowships and the like is strongly advocated.

Similar ideas have previously found expression in the report of the British Commonwealth Science Committee (see *Nature*, 152, 29; 1943) and Dr. Joseph Needham's proposals for an International Science Co-operation Service (*Nature*, 154, 657; 1944). They have been strongly emphasized in Britain, in the U.S.S.R. and in the United States in connexion with the recent visit of scientific workers to the Soviet Union to celebrate the two hundred and twentieth anniversary of the Academy of Sciences of the U.S.S.R. Co-operation with Russian men of science, said Sir Robert Robinson, in addressing the

Parliamentary and Scientific Committee, is absolutely necessary. Prof. E. N. da C. Andrade commented on the complete absence of suspicion, and on the value of personal contacts, particularly in view of the existing postal delays. With the opening of the Baltic and increased air service, an improvement in the postal services and in means of communication in general may be expected, but even so, as Sir Lawrence Bragg has emphasized elsewhere, it is often impossible to judge the value of a new theory or technique without personal visits or discussions. An interchange of advanced students would do much to increase understanding and to promote collaboration, and Prof. D. M. S. Watson on this same occasion referred to the evident desire of Russian scientific workers to keep in touch with scientific work and progress in the world also and for such interchange of young men of science and research students.

Several of the British visitors have surveyed very briefly their general impressions of Russian progress in the various branches of science, and elsewhere in this issue of *Nature* we are publishing some of these articles. From these it seems clear that Russian men of science and their Government desire such a two-way traffic. Prof. Andrade writes of the abiding impression made by the spirit of cordiality and co-operation in which the delegates were everywhere received. Prof. Watson refers to the real need for closer contact with workers in other countries, and especially of travel, and of the dependence of satisfactory work on such free association of workers in all lands. Prof. E. D. Adrian makes the same point even more emphatically in respect of physiology. Until the war-time restrictions on travel are removed, we shall not properly appreciate all that Russian physiologists are doing, and they will have no first-hand experience of our methods and ideas. We and they both need an exchange of students in addition to the exchange of journals.

Everyone is so aware of this, and the delegates were so cordially received, that it is hard to believe that the restrictions will remain, particularly in view of the speech of Kapitza on June 23, which showed that the U.S.S.R. recognizes the importance of international co-operation and that the Academy intends to promote international co-operation by these measures, all of which have been urged on the Government of the United States in Dr. Vannebar Bush's report. When Prof. Adrian concludes that the British delegates will only complain if they are not allowed to repay some of the kindness shown to them by their hosts, he is clearly expressing a common sentiment. It may be a further hopeful sign that there should since have been published the draft proposals for an educational and cultural organization of the United Nations, to be established, according to the preamble, in recognition that "co-operation in education and the furtherance of cultural interchange in the arts, the humanities and the sciences will promote the freedom, the dignity and the well being of all and thereby assist the attainment of understanding, confidence, security and peace among the peoples of the world"; and in dedication to the proposition "that the free and unrestricted education of the people of the world and the free and unrestricted exchange among them of ideas and knowledge are essential to the advancement of huma welfare and to the preservation of security and peace.

But for the effective promotion of scientific inte course across national frontiers, something more tha organization is required; and the point has bee uncomfortably emphasized in connexion with thi very visit to the Academy of Sciences of the U.S.S.R The appointment of scientific attachés might indee do something to increase the flexibility of organization, to promote more informal and intimate contact as well as to remove causes of misunderstanding Such a system may become imperative to the buildin up of the confidence essential for framing a system of co-operation in handling and harnessing to constructive purposes the new powers disclosed in th release of atomic energy; but so far, apart fron Great Britain's agricultural attaché in Washingto and Prof. E. Ashby's appointment to the Australia Legation in Moscow earlier this year, no practica steps have been taken to give effect to an idea whic has already been widely discussed among scientifi workers.

If the recommendations of Dr. Vannebar Bush' report are accepted, we may expect to see the Unite States also experiment with scientific attachés i certain embassies, and Dr. Bowman's Committee ha the U.S.S.R. specially in mind in making the suggestion. No system of scientific attachés, however can obviate the need for the handling of scientifi co-operation and communications with more understanding, not to say courtesy, by Governmen departments and officials generally.

The readiness with which scientific workers have accepted the restrictions on their freedom of communication does not mean that such restrictions should be imposed unreasonably or without regard to the common courtesies of civilized life.

It is on this ground that men of science in Britain have a right to protest firmly against the circumstances in which the exit permits of eight of their colleagues invited to attend the anniversary celebrations of the Academy of Sciences of the Soviet Union were cancelled at the last moment by the Government. We may leave the Foreign Office to deal with the discourtesy to the Soviet Government implied in such a cancellation; but however substantial may have been the reasons which decided the Government to withhold permission for these eight men to proceed to the U.S.S.R., we cannot reasonably be expected to believe that such a decision could not have been reached at a much earlier stage. The complete disregard of all personal considerations has undoubtedly roused strong resentment, and scientific workers owe it to themselves to protest emphatically against what appears to be a piece of bureaucratic incompetency or tyranny.

The right of the Government to impose restrictions on international scientific intercourse, at any rate in war-time, or to lay down conditions to which such intercourse must conform, is not challenged; though scientific men have a perfect right to consider for themselves whether it is worth proceeding with a particular foreign visit under particular conditions. Even with the improvement of communications through air transport, however, a visit to such a country as the U.S.S.R. is not to be undertaken without a certain amount of personal inconvenience. Responsible scientific men may have to obtain leave of absence and to arrange for deputies during their absence; private arrangements have to be made regarding homes or families; and in these days, in addition to passports and visas, there is usually inoculation against typhus or other diseases likely to be encountered, with all the physical discomfort or even incapacitation that is involved. No one complains if for some urgent and unexpected reason it is necessary to cancel at the last minute arrangements made in good faith, but common decency should forbid any one being put to the inconvenience involved in the preparations unless there is every reason to believe that he or she will make the journey.

Nor is it merely in regard to scientific workers leaving Britain that there are strong grounds for complaint of official slackness and discourtesy. The treatment of distinguished scientific visitors to Great Britain leaves a great deal to be desired. Both in entering and in leaving the country, such distinguished visitors, possibly invited by a scientific society of standing, may be obliged to spend the better part of a day awaiting their turn at government offices completing various formalities. There should be some mechanism whereby distinguished men of science entering or leaving Britain could be given the privileges accorded to those of ambassadorial status, for truly they are ambassadors of science. An intermediary is evidently required, able to keep in touch with learned societies on one hand and Government departments on the other. Such a body would be a centre to which those desiring to entertain foreign visitors would hand over all formalities; it might equally act for British men of science visiting foreign countries. Something on these lines is being done by the British Council, but more comprehensive action is required; the Council, however, if suitably strengthened, might be an appropriate body to undertake such activities.

Sir Henry Dale has pointed to some of the implications of the atomic bomb and the control of atomic energy for the full freedom of scientific intercourse; and the importance of full scientific intercourse across national frontiers, as already indicated, has never been more widely recognized. While the improvement of scientific communications is urgently required, and the relaxation so far as possible of the war-time controls over publication, it may still be necessary to retain some measure of Government control. Such restraint should be reasonable, however, and the minimum consistent with the national interests regarded from the broadest point of view. Scientific workers have a right to expect and to insist that Government departments to which the framing of the necessary regulations is entrusted are staffed with those competent to do their work with imagination and understanding of the real issues—constructively and not obstructively—and to administer and interpret them with common sense and courtesy.

METHOD IN METAPHYSICS

The Nature of Metaphysical Thinking

By Dorothy M. Emmet. Pp. xi+238. (London: Macmillan and Co., Ltd., 1945.) 10s. 6d. net.

MISS EMMET describes metaphysical statements as statements about the real which transcends experience. Her view in brief is as follows: There is a real world of which we are part and to which in our living we are responsive, but of the nature of which we have no direct experience. Nor have we any means of characterizing it as it is in itself, since in all our awareness, whether through sensing or through reasoning, what is displayed is rather our responses to it than its own nature. In this sense the real transcends experience.

But since we feel ourselves responsive to it, we can describe it indirectly in terms of our responses. We need not, however, confine ourselves to simple statements such as that 'the real is that to which we respond in such and such ways'. We want to tell a connected story about it, to make it out as having a structure which seems intelligible to us. Miss Emmet is concerned with the question of the ways by which we do this, what justification there is for doing it, and in what sense, if at all, the accounts we give in this way can be true.

The fundamental method on which she lays stress is that of analogy. This is used in science, in the building up of any theory. Some experienced arrangement which seems intelligible is taken as a model for the description of a situation the details of which cannot be experienced. Such a model is valuable not merely for predictions, but also as giving an intelligible co-ordination of various observed facts, and as a means toward the forming of more complex models in relation to wider situations; and while it cannot be taken as a literal representation of the situation as it is in itself, it can be taken as corresponding in some way to the situation, even though we cannot say directly how.

In religion, theology and metaphysics, analogies are used in the same way as in science. But there are certain fundamental differences. The former are concerned with what, following Prof. Stocks, Miss Emmet calls total assertions: assertions about the nature of the real considered as a whole, and therefore qualitative, whereas assertions in science are concerned with features from which quantitative relations can be derived. The basis of this difference is her view that some of our responses to the world are responses of our whole being to some feature of the world considered as an individual whole, while others are responses of part of ourselves to some partial feature of the world: somewhat as, for example, I may stand on tiptoe to help my tall friend to put on his overcoat (partial response to a partial feature), whereas my whole being goes out to him in admiration when he shows some special excellence of character (total response to a total feature).

I have no space to deal with Miss Emmet's interesting and careful account of analogies in religion and theology. A metaphysical system takes its rise in total responses. As a starting point, we can say that the world has such a nature as to rouse these responses in us. The next step is to seek for some further account of it which will enable us to link our various total assertions into an intelligible system. Analogy is fundamental here, as in science. Some type of situation is felt by a particular thinker to be of special importance within human experience, and also to provide a clue to that in the nature of the whole which calls out our total responses to it. Further than this, in principle, he cannot go, in his account of the whole. He can never say directly what it is in itself. His account remains analogical and symbolical.

Such an account of the real is valuable partly because of the way in which it enables us to co-ordinate our experiences in various fields. But it may be valuable in this way only for particular persons at a particular epoch; and this partly accounts for the variety of metaphysical systems. When a system has lost this value, it can still have a value of a different, though perhaps less exalted, kind. It brings out more clearly the significance of the system of relationships within experience which provided the original clue.

Miss Emmet admits that the present age is not favourable for system building. "The real problem is that our diverse worlds of thought do not make sense as a coherent unity." Even when the physical and the social sciences make a new synthesis possible "it may well be that . . . we shall have learnt that the old style synthesis in the grand manner is impossible". At the same time she feels that failure to reach some such co-ordination results for many people in a failure to achieve any sort of significant communication with their fellows. She suggests in her closing pages that our most pressing need is to get clear about the difficulties of communication. How can we get across the barriers which divide people whose types of experience are diverse? To answer this question we need more investigation into the nature and the potentialities of what she grandiloquently calls "the word". At the same time we should be alert to new "possibilities of responsive awareness", to be ready for a new master analogy.

Miss Emmet thus has quite modest expectations in regard to metaphysics, at least in our time, and for her modesty there should be nothing but approval. The doctrine in her book which needs most critical scrutiny is the view that some of our responses can be taken as responses to some qualitative feature of the world as a whole. She says that we can take them as such only by an act of faith, by which she means a decision which is different in kind from any decision based on reasoning or on considerations about probability.

But if so, assertions about the world based on these responses are pre-judgments which stand in need of justification. The kind of justification she offers is that of ~~coherence~~—success in giving a systematically connected account of the world, which appeals to us as intelligible, and which serves to clarify and to intensify those responses we took, on faith, to be responses to the world as a whole. I am sceptical about the value for knowledge of all this. I cannot work up any interest in the idea that we are responsive to features of the world as a whole; and the fact that there are many different accounts which claim to be coherent seems rather to indicate that the responses on which they are based are only partial. Very often "giving a coherent account" simply reduces to "telling a good story". A good story is itself capable of playing on people, and rousing in them responses which are quite easily interpreted as responses to the world, and which in this way increase the convincingness of the story: for this reason, I think, coherence is not a satisfactory test of truth in any field where responses of this indeterminate character form part of the material to be woven into the system. In scientific investigation, the important responses are those made by instruments; and while the interpretation of the response made by a scientific instrument depends on the general body of theory which is being developed by its aid, yet the response itself is independent of any theory. If the responses of the instruments were affected by the theories they supported, scientific workers would all be medicine men with inadequately controlled theories. Stories about the universe as a whole do not seem to be in any better case.

The book is an attractive one. Miss Emmet has a wide knowledge of theological and philosophical literature, often shows great delicacy of perception and has a fund of self-criticism which keeps her from thinking it a merit to get conclusions, whatever the evidence. I have only one complaint about her style She has a habit (which seems widespread nowadays of preferring abstract or generic nouns to concrete nouns. The subjects of her active verbs are rarely concrete nouns. Phrases such as "Conceptual activity orders and interprets . . .", "Faith confesses . . .", "The religious mind seeks . . .", "The religious symbol conveys . . .", "The word discloses . . ." are frequent in her pages. Abstract words have a place even in philosophical language; but in discussions of the kind dealt with in this book we cannot afford to flirt with plausible rotundities, which play on our emotions and put our critical faculties to sleep. The more concrete we can make our language, the better will be our chance of finding out how untrue are the things we say. In this lies our only hope, when we are trying to speak truly.

L. J. Russell.

THE POSTHUMOUS TESTIMONY OF AN ANTHROPOLOGIST

A Scientific Theory of Culture

And other Essays. By Bronislaw Malinowski. Pp. ix+228. (Chapel Hill, N.C.: University of North Carolina Press; London: Oxford University Press, 1944.) 18*s.* 6*d.* net.

BRONISLAW MALINOWSKI, born in Poland, died three years ago at the early age of fifty-eight. Besides carrying out detailed and exceptionally brilliant field-work in Melanesia and New Guinea and for shorter periods in Australia, East Africa and Mexico, as professor of anthropology in the University of London, and attracting to himself a large number of able students, he displayed throughout his life the keenest interest in developing the theoretical background of his subject. His well-known theory of culture, presented by him in this volume in its finally elaborated form, has been for many years before his anthropological colleagues and has met alike with acceptance and with severe criticism. It is couched in terms of 'functionalism'; and by 'function' he means "the satisfaction of human needs". Even 'basic' human needs (for example, those of hunger and sex) demand cultural satisfaction; and they become linked up with new, 'derived', cultural needs. Any analysis of culture, he says, "in which we attempt to define the relation between a cultural performance and a human need, basic or derived, may be termed functional" (pp. 38, 39).

Two-thirds of this book is occupied by the author's presentation of his "Scientific Theory of Culture". It is followed by two shorter essays, one entitled "The Functional Theory of Culture"—which he regards as "a mere sketch" (p. 175)—and the other, "Sir James George Frazer: a Biographical Appreciation" (tempered by some *de*preciation !), both of which help to clarify his position. All three essays travel far beyond their respective titles. But he regards the scientific study of culture as "the real meeting-ground of all branches of anthropology" (p. 4). Indeed the whole volume presents an invaluable critical examination of the past, present and future trends of the science of anthropology in each of its many aspects. It describes what appear to the author to be the uses and abuses of the various methods hitherto applied, and is thus a work which no student of modern anthropology or sociology can afford to ignore.

Malinowski's theory of culture is psychologically based on 'behaviourism', of a not extreme type. No doubt this attitude became strengthened when, towards the close of his life, he served as visiting professor at Yale University and came under the influence of the distinguished behaviourist, Dr. Clark L. Hull, who holds a chair there in psychology. Malinowski proclaims his sympathy with what he terms the latter's 'stimulus-and-response' school of psychology, and he stresses "the great importance which behaviourism promises to acquire as the basic psychology for the study of social and cultural processes" (p. 23), because it "allows us to describe facts which can be observed" (p. 71). He wisely warns us of the dangers of what he terms the "psychological method" of considering "what the primitive might have or ought to have thought or felt under certain conditions, and, how out of such a thought or feeling, a custom, belief or practice crystallized" (p. 19). Yet two facts are inescapable: that not every human action can be regarded as a sensori-motor function, and that in behaviourism the introspections of the conscious subject are only too apt to be replaced by the interpretations of the conscious observer.

Malinowski gives the name 'institution' to each unit of organization into which culture can be analysed; in his view the institutional structure of every culture must be recognized. "No element, 'trait', custom or idea is defined or can be defined except by placing it within its relevant and real institutional setting" (p. 54). He recognizes seven "general principles"—a rather heterogeneous medley listed by him as reproduction, territorial, physiological (due to age, sex, etc.), voluntary associations, occupational and professional, rank and status, comprehensive ("the integration by community of culture or by political power")—which bind human beings together into permanent groups. Under each of these so-called "general principles" he lists a large number of universal institutional types which he allocates to the "general principles" from which, he believes, they have been derived; for example, the family, kinship, marriage, co-operation within and outside the household, the sexual differentiation of labour, secret societies, occupational institutions, distinctions of class and caste, and institutions arising from the exercise of authority. Such a scheme, even if theoretically inadequate, will at all events, as he urges, prove helpful to the student and to the field-worker investigating an unknown area, and as a measure in comparative research.

The author's next task is to list under three vertical columns, respectively headed (in functional terms) "impulse", "act" and "satisfaction", eleven "permanent vital sequences" (for example, hunger, thirst, sex-appetite, somnolence, bladder-pressure, fatigue and fright) which he regards as "incorporated in all cultures", in accordance with his view that all cultures have essentially a physiological basis. He proceeds to show how the "act" and the "satisfaction" of these "vital sequences" are regulated, defined and thus modified by culture. Next, he sets forth the "basic needs" of human communities (for example, bodily comforts, health and safety), and he considers in respect of each of these needs the "cultural responses" which are derived from them and the "derived needs" to which under social conditions they have given rise. Finally, he analyses these "derived needs" or "cultural imperatives" under the four main lines of cultural response to them, which he defines as economics, social control, education and political organization.

Malinowski lays stress on the distinction that must be drawn between the tribe-State and the tribe-Nation, that is, between the tribe as a political organization and the tribe as a cultural unit. Whereas the "charter" of a tribe-State—its purpose as entertained by its members—"is that unwritten but never absent constitution of authority, power, rank and chieftainship" (pp. 165, 166), the charter of a tribe-Nation is to be "found in those traditions that deal with the origins of a given people" and describe "their cultural achievements in terms of heroic ancestral performance" (p. 165).

"Culture", Malinowski wisely concludes, with special reference to present-day conditions, "as a way of life, as a national type of pursuit, taste and interest, cannot be dictated, controlled or legislated. It ought to be given the best conditions for development, and cross-fertilization with outside influences, but left to maintain its own balance and its own development under conditions of full autonomy" (pp. 220, 221). Anthropological analysis "would reveal that nationhood is a much older and more fundamental principle in evolution than the political organization of a police system, a tribe-state, or an empire" (p. 217).

C. S. MYERS.

A NATURALIST OF THE HIGHLANDS

A Highland Year

By Seton Gordon. Pp. 152+23 plates. (London: Eyre and Spottiswoode (Publishers), Ltd., 1944.) 12*s*. 6*d*. net.

MR. SETON GORDON is one of the few men of education who have been content to live their life in the Highlands rather than earn what many would consider to be an easier and better living elsewhere. The result is that, being a life-long observer, he knows more about the natural history of a remote region than almost anyone else. He has preferred to diffuse his wide knowledge in the form of popular books rather than as systematic papers, a fact for which many general readers are undoubtedly thankful. We of a younger generation of workers may be sorry that he does not give us a compendium or source-book which he alone could write and which would preserve for us the great variety of knowledge which his sensitive, inquiring mind has gathered. Nevertheless, here is a book written graciously, one which in the opinion of the reviewer stands out as Seton Gordon's best.

The only plan the book can be said to follow is based on the title of "A Highland Year", the chapters being the months, beginning at October, which is a good choice. Within his months, Seton Gordon allows himself complete freedom of anecdote and description, jotting down in leisurely fashion an immense range of facts of natural history. Observers studying bird behaviour will find several points of interest: for example, a case of a black-throated diver moving her eggs from one islet to another in a hill loch during a heavy spate. This bird continued to sit on the eggs in their new place. A wagtail's nest in a quarry on the new Glencoe road was moved several yards by the navvies to a new site on the quarry floor, where they built a cairn round the nest to give it shade and protection. The birds continued to sit in the new place and reared their young, blasting, lorry-loading and hubbub notwithstanding. These occurrences are in such sharp distinction to that narrowly limited pattern which Howard with corn buntings and Kirkman with black-headed gulls have shown to be common in the perception of the nest site.

The influence of man on wild animal life in Scotland is described in many notes. Ptarmigan, for example, are extinct in the Forest of Harris, their last haunt in the Outer Isles. Rabbits increased to such an extent on the Slopes of Clisham, the highest hill (2,665 ft.), that someone put down ferrets. It would not have needed much actuarial knowledge to have contrasted the reproductive potentials and expectations of survival of these two species. Ptarmigan have gone; the rabbits remain. Less than a century ago, the pine marten was common in these treeless hills, but its influence on the ptarmigan was apparently much less harmful than that of the ferret.

Seton Gordon often speaks of the lobster fishery of the West Highland and Hebridean coasts: it has been prosecuted with intensity during the War, but as yet we know little or nothing of the cropping potential of this valuable wild-life resource. It is unfortunate that public opinion has not yet enforced what provident common sense dictates in the handling of these shellfish. Lobsters are still sent to Billingsgate alive with an estimated consequent loss of 25 per cent. Many lobster fishers still 'cut' their catch, that is, prevent these shellfish fighting in the crowded conditions of the box by severing the tendon of the main claws at the joint. This suffering could be eliminated by installation of 'quick-freeze' plants in the catching areas and transport costs would be reduced.

Seton Gordon the naturalist tends to overshadow the judge and talented player of the Highland bagpipe. He is an authority on *ceol mor*, the 'great music' of Gaeldom. The *piobaireachd* is a severely disciplined classical form comparable with the fugue, but a bigger thing altogether; yet the author of this book considers, with other pipers, that *piobaireachd* is dying. Is this because the bagpipe remains a solo instrument for its classical music, and times and places are few in modern life when this form can be appreciated? Perhaps we may yet see the *piobaireachd* orchestrated and brought to a wider field of music lovers. F. FRASER DARLING.

FOOD SCIENCE

The Chemistry and Technology of Food and Food Products

Prepared by a Group of Specialists under the Editorship of Dr. Morris B. Jacobs. Vol. 2. Pp. xx+890. (New York: Interscience Publishers, Inc., 1944.) 10.50 dollars.

HALF of this volume is concerned with unit operations and processes (describing generally the methods and equipment involved in the preparation of foods), food supervision by government agencies, sanitary and quality control, food machines, plant sanitation, control of insects and rodents, dehydration, food preservation by temperature control and by micro-organisms, canning, chemical preservatives and packaging. The other half deals with production and covers the milling of cereals, bread and bakery products, sugars, chocolate, fruit juices, milk and milk products, meats, oils and fats, beverages and industrial waters.

The book suffers from the weakness of being too comprehensive, and as a result many important aspects are dealt with inadequately. It is doubtful if the section on food supervision will interest the average food technologist, while the engineer interested in machines for food processing would probably gain more from a study of the elaborate catalogues produced by manufacturers. By contrast, the section on plant sanitation is so loaded with detail that the principles and remedies tend to be lost. The sections on insect and rodent control make interesting reading, but it is obvious that American work is behind our own on, say, the question of insecticidal dusts. Again, no mention is made of critical moisture contents in relation to insect spoilage.

The dehydration of foods is dealt with in masterly fashion but to anybody who has investigated or even eaten these products, it is no surprise to learn that the conditions of storage are vital to palatability. The authors also fight shy of the nutritional aspects of these foods, while no mention is made of compression as a method of saving space and packaging.

Food preservation by temperature control is written by Dr. Tressler, a noted authority on this subject. He has, however, too much ground to cover in twenty pages, and as a result he inevitably sounds dogmatic even on difficult and complicated points such as the meaning of and the desirable relative humidity for the storage of a particular foodstuff at a given temperature.

The sections on production are all first-class, as would be expected from the names at the head of them. When they are objective, however, they refer inevitably to American practice. Thus Dr. Urbain gives a lucid account of operations in the Chicago stockyards, Prof. Geddes makes no mention of wheat blending which is of such interest to many European countries, and also scarcely mentions rye, while discussing maize in some detail. On the other hand, there is a stimulating section on alcoholic beverages, which includes a short chapter on Scotch whisky.

This volume, like its predecessor, is largely an account of American laboratory and commercial experience on the properties and production of foods. It is, however, a welcome addition to the literature on food technology, and Dr. Jacobs is to be congratulated both on his courage and his achievement.

T. MORAN.

ACADEMY OF SCIENCES OF THE U.S.S.R.

220th ANNIVERSARY

UST over a month after the Red Army had captured Berlin, the Academy of Sciences celebrated its vo hundred and twentieth anniversary by in-ting scientific workers from all over the Soviet nion and from eighteen foreign countries to meet Moscow and Leningrad. It was a very generous esture from a nation which has suffered so severely om the War, and it is evidence of the importance hich the U.S.S.R. attaches to international contacts ı science. For two weeks some nine hundred scientific orkers were guests of the Soviet Union. All the plendour of Russian hospitality was given to them. here were lectures and demonstrations and excurions. Soviet laboratories were freely opened for ıspection. Most foreign delegates came away with ery generous gifts of reprints and books and pecimens: for example, the four foreign botanists ach received a set of the ten volumes already pubished of the Flora of the U.S.S.R.

There were British delegates from the United Kingdom, Canada, Australia and India. Among the ther foreign countries represented were the United States, France, Sweden, Poland, Hungary, Yugoslavia, China. The visitors included many very istinguished men: Adrian, Joliot-Curie, Langmuir, Szent-Györgyi, Svedberg, to name only a few.

The celebrations opened in the evening on June 15 with a reception by the president of the Academy, Prof. Komarov. On June 16 the first celebration meeting was held in the Bolshoi Theatre. There were speeches from Komarov, Bruevitch, Orbeli, Prianishnikov and Kapitza. After the meeting there was a banquet for more than fifteen hundred guests, which continued until the early hours of the morning, and gave the delegates an excellent opportunity to overcome any shyness they might have had. On June 17 the Academy organized visits to museums, etc., in Moscow, and in the evening there was a second formal meeting at which the veteran Zelinski spoke, and greetings to the Academy were read by Shapley (from the United States), Sir Robert Robinson (from the Royal Society), Maurice Caullery (Paris Academy of Sciences), and others.

June 18, 19 and 20 were occupied by sectional meetings, visits to laboratories, and special performances of the opera and ballet. Several informal meetings of specialists were held: one on biochemists attended by Parnas, Szent-Gyorgyi, Englehart, Adrian, Needham, and others; one on physical chemistry, addressed by Langmuir, Macbain, Hinshelwood and Svedberg; one on soil science, addressed by members of the Dokachaieff Institute (under Praslov), and by Ogg and Kellogg. Lysenko addressed a special meeting on his theory of variability in inheritance. The next two days were spent in excursions: a boat trip on the Volga canal and a trip to Tolstoi's home at Yasnaya Polyana.

On June 24 the delegates were privileged to see, in the Red Square, the impressive Victory Parade. The salute was taken by Marshal Stalin and Marshal Zhukov, and despite pouring rain the parade was followed by patriotic demonstrations from the citizens of Moscow. That night three special trains left Moscow to take the delegates to Leningrad.

Leningrad gave the delegates a delightful welcome. Many of them were presented with bunches of flowers at the station. The first engagement was a tour of the "Defence of Leningrad" museum, which gives a vivid idea of the terrible privations the people of Leningrad have recently suffered. In the evening there was a performance of "Swan Lake". The next two days were occupied by meetings, visits to laboratories, and excursions. There were visits to the ruined observatory at Pulkovo, to Joffe's physico-technical institute and his physico-agronomical institute (under the Lenin Academy of Agricultural Science), to the Botanical Institute and garden, to Orbeli's physiological institute, and to other places. At a formal session of the academy, Orbeli gave an account of the work of the Pavlov school of physiology, and Komarov was admitted to foreign membership of the Linnean Society of London by its representative at the celebrations, Prof. E. Ashby.

On June 27 the Leningrad Soviet entertained more than a thousand guests to a banquet in the magnificent Uritsky palace. On June 28 there was an excursion to Koltushi, the laboratory where Pavlov worked, and where work is being done on the genetics of behaviour in animals, birds and *Drosophila*, and on the evolution of function in animals.

The delegates returned to Moscow on June 29 and in the evening they attended a special concert. On June 30, the Soviet Government gave a banquet in the great St. George's Hall of the Kremlin. Marshal Stalin, President Kalinin, Mr. Molotov, Marshal Voroshilov, and other leaders of the U.S.S.R. were the hosts.

British men of science who attended the conference are surveying work in their own fields which they have seen. Its quantity and quality in some branches of science were very impressive. Even during the darkest days of the War, scientific research went on. Of course, much of the energy of the Academy was devoted to the solving of short-term problems connected with the War, and one of the keynotes of the celebrations was the gratitude of the Russian people for the contribution of Soviet scientific workers to victory.

For the foreign visitor the celebrations were a generous token of the intention of the U.S.S.R to promote international co-operation in science. Through the initiative of the Soviet Government, contacts between Soviet scientific men and their foreign colleagues, so seriously dislocated by the War, have now been repaired. The hope of every foreign delegate is that the good promise of these two weeks shall be fulfilled. Perhaps the most important occasion of the celebrations was Kapitza's speech on June 23. He pointed out that the U.S.S.R. recognizes the importance of international co-operation in science, and that the Academy intends to promote international co-operation by three measures: (1) enlarging and extending its publications of scientific work in foreign languages, and publishing monographs in Russian, English, or French; (2) arranging and taking part in international congresses; (3) exchanging scientific workers between the U.S.S.R. and foreign countries. If, as a result of these celebrations, foreign men of science can keep in touch with their Soviet colleagues, can meet them at congresses, and even work with them occasionally, then the celebrations will be much more than a delightful experience: they will be the first step on the road to stable international co-operation.

SCIENCE IN THE U.S.S.R.

PHYSIOLOGY

By Prof. E. D. ADRIAN, O.M., F.R.S.
University of Cambridge

IN the summer of 1935, physiologists from all over the world gathered in the U.S.S.R. to attend the international Congress held in Leningrad and Moscow. Though we knew that scientific men there were held in high esteem and that our president, the renowned Pavlov, had every privilege the State could grant, we were not at all prepared for the magnificence awaiting us and for the intense interest which the doings of the Congress seemed to arouse in everyone we met. Whatever our political colour, we had to conclude that in the U.S.S.R. scientific workers were genuinely regarded as estimable people to be encouraged at all costs.

Ten years later, the jubilee meeting of the Academy of Sciences of the U.S.S.R. has reinforced this impression. We have been dazzled as before by stately entertainment, but although the spirit of victory was in the air, the meetings of the Academy were not merely an overture to the military parade before the Kremlin. We celebrated the achievements of Russian science, past as well as present, in all its branches, in archæology, linguistics and exploration as well as in aeronautics and chemistry. Clearly science and learning still hold an exalted position in the U.S.S.R. and the title of 'academician' carries more weight there than in any other country in the world.

What has science done to deserve such esteem ? In the U.S.S.R., as elsewhere, it has played an essential part in the War, and the great development of the country would have been impossible without it. For the man in the street, the achievements of science may be measured by the 'metro' and the higher yield of agriculture ; but the man in the street seems to read text-books on physics or astronomy (to judge by their sales), and it is evident that the respect for science owes something at least to the particular philosophy on which the State is based. Guided by this philosophy, the State is willing to spend very large sums on research institutes of all kinds and to keep large numbers of men of science working on problems of the more academic type in spite of the War and the shortages it has caused.

This is certainly its policy in physiology. The War has naturally focused attention on the nature of surgical shock, on blood transfusion and resuscitation, etc., but work on such problems as the chemistry of muscle and the development of functions in the embryo has continued, under difficulties of course, but with no lack of interest and official encouragement. Near Leningrad, where one in three of the inhabitants died of starvation in the siege, the large experimental station built for Pavlov at Koltushi is already a hive of activity. It has modern equipment and houses more than fifty scientific workers and many more technicians engaged on the problems of the nervous system. In the city itself, the large Pavlov Institute of Physiology is in full swing. In Moscow, work has gone on continuously in the research institutes directed by Academicians Orbeli, Lina Stern and Englehart. Many of the scientific workers in these institutes are women, but by no means all, and many papers have been publishe during the war period, some concerned with war-time problems but the majority dealing with pure rathe than applied physiology.

How far has this large-scale encouragement of science been justified by results ? In physiology ther have been few outstanding advances in recent years in the U.S.S.R. or anywhere else. The result which justifies the policy has been the general raising o standards, in equipment, in training and in th quality of the work that is published. In 1935, a now, the senior physiologists were men of established reputation, pupils of Pavlov, Samojloff or Wedensky but the juniors had little experience of physiology outside their own laboratories and could scarcely avoid some restriction of outlook. The training is now much more thorough, the libraries are better and there is far less reliance on traditional methods. The papers which are published reflect this improvement. The specia features of Russian physiology remain. There is the same keen interest in the central nervous system and in the interaction of the different regulating processes of the body ; but in addition there is the tendency to explore new fields with new techniques which has been characteristic of physiology elsewhere. A good example of this has been the recent almost simultaneous appearance of work on the electric response of the human eye from Moscow, Stockholm and Cambridge.

In the years to come, the U.S.S.R. with its large numbers of trained physiologists will have an output of research in that subject exceeding anything in Europe. There is little to criticize in the organization for this research. Whether the policy of large institutes with a pre-arranged plan is as good for physiology as it is for agriculture does not matter very much, for if it does not work it will be altered, as recent educational policy has been altered. On paper, the director of an institute may seem to have an uncomfortably large number of scientific workers to look after, but in fact he can probably trust most of them to look after themselves. The director has considerable power over his staff. Yet in any country the junior who disproves his professor's conclusions may find his position difficult, and there is no reason to think that these difficulties would be increased by the particular organization of the research institutes in the U S.S.R. But the physiologists there have had one disability which, if it persists, will certainly check the rapid development of the science. In the past, only a few of them have been able to visit laboratories in other countries for study and research. During war-time, restrictions on movement are inevitable and we have all suffered from them. Until they are removed we shall not properly appreciate all that Russian physiologists are doing, and they will have no first-hand experience of our methods and ideas. We and they both need an exchange of students and professors in addition to the exchange of journals. But everyone is aware of this, and we have been so cordially received on our visit that it is hard to believe that the restrictions will remain. It is significant that the first international meeting of scientific workers has been held in the U.S.S.R. Those of us who had the good fortune to attend it cannot complain of any lack of co-operation. We shall only complain if we are not allowed to repay some of the kindness shown us by our hosts.

CONTEMPORARY PHYSICS

By Prof. E. N. da C. ANDRADE, F.R.S.
University College, London

T must, of course, be clearly understood that the following brief notes do not profess to mention, even by name, every important line of research in physics that is going on in the U.S.S.R.; they cannot even hope to mention everything of interest that I personally saw during our recent visit as guests of the Academy of Sciences. They must be taken, rather, as general impressions left by the varied activities of the laboratories in which we were so warmly welcomed by our Russian colleagues, who were anxious to let us see the progress that they were making in the world of research, but equally anxious that we should not miss any of the receptions or festivities so bountifully prepared.

The leader of Russian physics is Academician A. F. Joffe, vice-president of the Academy of Sciences, who first began in 1903, in conjunction with Röntgen, the work on crystals which, in one form or another, has always occupied his attention. His book on the physics of crystals is known to most English physicists. He is now sixty-seven, but in full vigour and actively controlling a great variety of research, as well as pursuing his own investigations—a comment on the British system of fixing sixty-five as the retiring age in most scientific posts. In the Physico-Technical Institute at Leningrad, which is under his immediate direction, work is mainly concentrated on three general subjects, namely, semi-conductors, intermolecular forces in polymers and nuclear problems. It must be understood that the Institute was transferred to Kazan during the siege of Leningrad and did not return until March this year: it says much for the vigour of the laboratory that work is already in full swing on the first two subjects named, and it is not surprising that the nuclear work is only just beginning. The spectral distribution of particles emitted by the nucleus is the general theme that is to be undertaken.

Work on semi-conductors has for many years been a favourite subject with Joffe, and arose naturally out of his interest in the real structure of crystals. The investigations have been much influenced by a theory of the rectifying effect put forward some years ago by Joffe and Frenkel; incidentally, Frenkel's theoretical work pervades many branches of present-day physics in the U.S.S.R., and I much regret that a change in our general plans interfered with an appointment for discussion which we had made. Semi-conductors can show what may be for brevity termed both electronic and ionic conductivity, or positive and negative conductivity. It has been demonstrated in Joffe's laboratory that the same substance, for example, lead sulphide or thallium sulphide, can be produced with either high or low conductivity and with either positive or negative conductivity, according to the amount and the nature of small admixtures of certain substances. Excess of sulphur gives positive conductivity, excess of metal, negative. Active work is proceeding on many lines, both on the fundamental physical properties of semi-conductors, which throw light on the mechanism of conduction in solids, and on their practical use for industrial rectifiers. This combination of pure and industrial research in the same institute is typical of the U.S.S.R. system. Closely connected with the work on semi-conductors is that on photocells. The thallium sulphide cell developed under Joffe gives up to 8 milliamp. per lumen. In many of his own researches Joffe enjoys the collaboration of the charming Madame Joffe, who acted as our hostess on more than one occasion.

Work on dielectrics is also proceeding. For example, the dielectric properties of hexafluoride of sulphur, which has an electrical strength two and a half times that of air, are under investigation.

As regards the work on polymers, much is being done in the way of cross-linking the molecules of cellulose by acting on the hydroxyl groups, a process somewhat analogous to the vulcanization of rubber. In this way the fibres can be made either elastic or brittle, and filter papers have been prepared which retain their strength in water.

All kinds of physical work in other laboratories is under Joffe's general direction. He has, for example, taken a leading part in organizing work on the measurement of soil temperature by an ingenious new method and on the measurement of the temperature of leaves, which has led to important practical results in agriculture.

Academician P. Kapitza (or Kapitsa, as his name is usually transliterated by the Russians) has a splendid modern Institute for Physical Problems, built in 1935–36. The most striking work proceeding here is, on the pure side, that on the superfluidity of helium II, discovered independently in 1937 by Kapitza in Moscow and by Allen and Misener in Cambridge, and, on the applied side, that on the liquefaction of air by Kapitza's turbine liquefier and on the preparation of liquid oxygen from the liquid air by a new type of apparatus for fractional distillation. Kapitza has recently been studying heat transfer in helium II in its relation to superfluidity and has found that the supposed abnormal heat conductivity is really a manifestation of its abnormally low viscosity. Connected with this is the existence of a counter current in the liquid. There are also two possible velocities of sound in helium II, the existence of a 'second sound' having been recently shown experimentally by Peshkov. These most curious properties of liquid helium have been explained in a remarkable theoretical paper by Landau. Work in this field is being actively continued. As regards the production of liquid oxygen on an industrial scale, the turbine liquefier, described just before the outbreak of the War, has the great advantage that it can be started up very rapidly and that it is much smaller and easier to maintain than the conventional machine. One machine is said to have run non-stop for four thousand hours. The methods of producing liquid oxygen developed in Kapitza's institute are being installed in factories all over the U.S.S.R.

There are various special institutes in which physics enters largely, although not exclusively, into the work. The Optical Institute is probably the largest, employing in all about five thousand workers; an account of one of the most interesting developments there, Maksutov's meniscus telescope, was given in *Nature* of June 30, p. 798. The Institute for Theoretical Geophysics deals with geoprospecting by electrical, seismic and magnetic methods and by a new thermal method; with atmospheric electricity and the transparency of the atmosphere; with ionospheric phenomena; and with the light of the night sky, on which Khvostikov has worked extensively. Some of the work in Academician Semenov's Institute of Chemical Physics, housed in a converted palace, is of a very physical nature, as, for example, a special method of measuring the abnormal viscosity which certain liquids have in layers immediately adjacent to a solid boundary: this method consists in blowing off the liquid with a controlled current of air and measuring the dimensions of the resulting wedge-shaped film by interference methods.

Academician Sergei Vavilov, director of the Lebedev Physics Institute, who is in charge of research at the Optical Institute, is keenly interested in the history of physics: he published a Life of Newton in 1943, in connexion with the tercentenary celebrations of Newton's birth, and edited a collection of papers on various aspects of Newton's work, to which he contributed a chapter on aspects of Newton's optical work. He also contributed a study of Galileo's work on optics to a recently published Russian work on Galileo. He tells me that he is now engaged on a complete Russian translation of Newton's "Lectiones Opticæ": the English translation which appeared in 1728 is of the first part only.

Reference must be made to the work of Rehbinder on the effect of surface-active substances for facilitating the working of metals, and particularly to some very interesting recent work on the effect of surface-active films in decreasing the resistance to mechanical flow of single crystals of metals. These films send up the electrical resistance appreciably, indicating that they penetrate deep into interstices in the metal.

If it does nothing else, this brief account may give some idea of the variety of the work in pure and applied physics that is proceeding with vigour in the U.S.S.R. It cannot, however, convey the spirit of cordiality and co-operation in which we were everywhere received, which has left a deep and abiding impression in our minds.

ARCHÆOLOGY AND ANTHROPOLOGY

By Prof. V. GORDON CHILDE

University of Edinburgh

ARCHÆOLOGY and anthropology are classed as sciences in the U.S.S.R. and with other social sciences stand under the ægis of Akademiya Nauk as much as the natural sciences. Hence during the War, archæologists and anthropologists have been 'reserved' like geologists or physicists. However, several very promising men of the younger generation, notably E. Krichevskiў, perished during the siege of Leningrad, and the gaps left by such casualties will take time to fill. At the same time, archæological research naturally suffered worse dislocation since 1941 than that in sciences more directly related to the war effort.

Museum collections had inevitably to be packed up. But in Moscow the State Historical Museum is already re-installed fully and open to the public; in the University of Moscow, despite considerable damage sustained by the building, the collections of the Anthropological Institute are actively in course of reinstatement, and I was able to handle the skull of the Neanderthal boy from Teshik Tash in Uzbekistan. In Leningrad the treasures of the Hermitage were not due to come back from hiding places in the Urals until August; in the Ethnographic Museum of the Academy an impressive exhibition illustrated by choice specimens, hastily unpacked and specially arranged by the staff, anthropometric, archæological and ethnographic work of the last ten years. Terrible damage, on the other hand, has been done to the famous collections in Kiev and in many local museums in the Ukraine and the Caucasus, where much unpublished material has been destroyed or dispersed by the invaders. A fine Hellenistic sarcophagus from the Taman Peninsula, abandoned by the Nazis, has just been restored in Moscow from the fragments to which the enemy had deliberately reduced it.

Field-work and the study of the collected materials were never entirely suspended during the War. The exhibition in Leningrad and a special session of the Institute for the History of Material Culture (IIMK held in Moscow introduced the Academy's guests to the results of operations so recent that no published accounts have reached western Europe. In Transcaucasia, Zamiatnin's surveys of Abkhasia, initiated in 1934, have brought to light the first undoubted Acheulean hand-axes from the territories of the Union as well as flake industries of Clactonian and Mousterian types, all illustrated at Leningrad. Tolstov described before the Institute the main results of the expedition under his direction in the ancient Khorasmia (the lower Oxus valley). The earliest settlements discovered belong to hunter fishers whose ceramic remains show analogies with the chalcolithic cultures of western Siberia and the Russian steppes. To the later Bronze Age belong some very schematic rock-engravings, while during the first millennium B.C. an advanced urban civilization, based on irrigation, developed. From the fourth century A.D. cities began to give place to isolated castles and fortified manors. At the same session Passek described her first explorations at Vladimirovka in the Bug basin, a large village of the 'Painted Pottery Culture' often called Tripolyan—excavations abruptly terminated by the Nazi invasion in 1941. Her survey has revealed there the existence of half-subterranean dwellings (*zemlianki*) as well as no less than five rings of *ploshchadki*. The 'areas' of burnt clay designated by the latter term turn out to be the floors of rectangular houses, which have been baked by fires specially kindled upon them and on which are found clay ovens, ritual pedestals, querns and groups of vases. These observations confirm and supplement the conclusions drawn from the excavations at Kolomishchina on the middle Dnieper, published with full documentation (in Ukrainian with French and Russian summaries) in *Tripil's'ka Kul'tura* (Kiev, 1941).

In physical anthropology the outstanding exhibits in Leningrad were the reconstructions from the skeletal material of faces and busts ranging from the Neanderthaler of Teshik-Tash to historical personages like Timur and Yaroslav Mudryў, executed by the sculptor anthropologist, Gerasimov, and exhibited with a convincing explanation of his methods. At the same time an anthropometric study is in progress on the abundant skeletal remains from the Fatyanovo cemetery of Balonovo near Kazan, while Debetz is in eastern Siberia continuing his anthropometric survey. Similarly Okladnikov, being again in Yakutia, could give no account of his interesting archæological and ethnographic discoveries along the Lena. For the same reason, we must await publication to hear of Grakova's latest finds in Fatyanovo cemeteries and her geographical and chronological classification of Fatyanovo relics, which is already prepared for publication.

Publication of archæological and anthropological periodicals in Moscow and Leningrad has been suspended during the War, but not in the Transcaucasian republics—the Georgian branch of the Academy, for example, published Kuftin's "Earliest Roots of Georgian Culture in the Caucasus in the Light of Archæology" (using also philological evidence and that from early MSS. miniatures) in 1944. Moreover, the complete editions of two numbers of *Materialy i Issledovaniya* were annihilated by enemy action in Leningrad. Now No. 12 of *Kratkie Soobshchennie* has already been issued and new volumes of *Sovietskaya Arkheologiya* and similar publications are going to press. At the same time, even during war years, excellent works of popularization were published by the Academy, such as histories of the ancient world and of the Middle Ages, edited respectively by Struve and Kosminsky and both designed for middle schools. An exhibition of all its publications in the domain of social sciences was organized in the Academy's library and profoundly impressed Western visitors.

VERTEBRATE PALÆONTOLOGY

By Prof. D. M. S. WATSON, F.R.S.
University College, London

THE study of fossil vertebrates in the U.S.S.R. is concentrated in the Institute of Palæontology of the Academy of Sciences in Moscow, but two men who hold posts in Leningrad are doing important work in association with the Institute.

Fossil fish of many ages are found in the Union, often most beautifully preserved and of great interest. Asiatic Russia has produced a Lower Old Red Sandstone fauna, the Leningrad district a series of faunas from the top of the Middle Devonian upward, which are generally represented by perfectly preserved though fragmentary remains, and are of great interest because they are comparable with those of the Upper Old Red Sandstone of Scotland, the Rhineland, North America, and the Arctic regions. Carboniferous, Permian and Jurassic fish are known from Asia in perfect preservation; there are even late embryonic Palæoniscids!

The early Tetrapod faunas are represented by two horizons, known nowhere else in the world, which are more recent than the Artinskian Clear Fork of Texas, and older than the Tapinocephalus zone of South Africa. These faunas include Labyrinthodonts of structure intermediate between those of the Lower and Upper Permian, which are of much importance for our understanding of the evolution of the group, and they have yielded an extraordinary, extremely flattened animal which seems to be a Seymouriamorph. There are new Cotylosaurs of great interest, but the most striking specimens are those of mammal-like reptiles, belonging to the Deinocephalia, which bridge the structural gap between the Pelycosaurs, and specifically the Sphenacodontia, of Texas, and the South African Titanosuchids and Tapinocephaloids. These animals are perfectly preserved; indeed, the bones from one locality, where they occur in essentially quite unconsolidated sand, appear like fresh bones, the skulls being completely free of matrix inside and out, and complete skeletons are known. With them is found *Venjukovia*, a forerunner of the Dicynodons, perhaps an actual ancestor of *Endothiodon*, itself derived from a primitive Tapinocephaloid.

On the River Mesen there occurs a "M." Permian fauna of small animals which includes two Cotylosaurs essentially ancestral to *Procolophon*, and a remarkable reptile, *Mesenosaurus*, the rather Pelycosaur-like skull of which is in some ways most reminiscent of *Youngina*, and which may perhaps prove to be the ancestor of the whole group of Diapsids. The later Permian and Triassic Tetrapods include a varied assemblage of Labyrinthodonts and Seymouriamorphs of great interest, many Pareiasaurs and Dicynodonts, Gorgonopsians, Therocephalia and a most primitive Cynodont, all comparable with African animals.

The Tertiary rocks of the Union in Europe and Asia have already yielded mammalian faunas of many horizons from the Oligocene to to-day, and are being actively explored. Indeed, the Museum of the Institute has already mounted a splendid skeleton of a Lower Meiocene long-jawed Mastodon, perhaps the best in the world. They have half a dozen mounted skeletons of fossil rhinoceroses, including that of the giant *Indricotherium*, and much other material of equal quality.

It is evident that the collecting expeditions have been most ably carried out, the materials must have been properly bandaged, the preparation is perfect, and the Institute has an excellent artist and photographer.

Vertebrate palæontology, like palæontology in general, is essentially an international science; conclusions about phylogeny can only be drawn with any satisfaction after a study of the whole materials in the world—and the U.S.S.R. includes a very large part of the world. Lying as it does over a great continuous land mass between North America, India, Europe, and, though it does not directly meet that continent, also Africa, it may be expected to form the link between these regions of the earth and thus provide the solution of many problems of correlation of terrigenous deposits of all ages throughout the globe.

The palæontologists in the U.S.S.R. know more than a hundred entirely new localities which yield vertebrate fossils and are making arrangements for their exploration. There is, to my mind, no doubt that in the immediate future the U.S.S.R. will become the great centre of activity of vertebrate palæontology, giving us new facts in abundance and solving many outstanding problems of phylogeny and of migration.

It was therefore most pleasing to me to meet my colleagues in Moscow and Leningrad, to spend some happy days in discussion with them, and to establish a friendship which will, I hope, continue for many years. The group is composed of most active, enthusiastic and able men and women, in whose hands I feel that the future of vertebrate palæontology may safely rest.

But a real need is that of closer contact with workers in other countries, and especially of travel. It is essential that every palæontologist should be familiar with his materials, and they are preserved in museums all over the world. The Soviet workers should be able to visit the British Museum and those in America and Europe as easily as we can, and I, and my colleagues in England and America, should be able to visit the U.S.S.R. and give to the magnificent collections which are accumulating there the study which they deserve. It is on such free association of workers in all lands that satisfactory work on fossil vertebrates ultimately depends.

MEDICINE

By Prof. ARNOLD SORSBY
Royal College of Surgeons of England

THE normal correctives of sensational reports on medical activities at any particular centre or country are close personal contacts and a free flow of publications. Both these are conspicuously lacking in our relations with Soviet medicine, and it is therefore inevitable that our knowledge of Soviet medicine is at all times inadequate, and at times grossly misinformed. This is unfortunate, for Soviet medicine has a significant organization and substantial achievements.

The organization of Soviet medicine is conditioned no less by the immense territory of the Soviet Union than by the assured place research has in the organization of society. The territorial expanse imposes a considerable amount of decentralization. This is apparent in the structure of the medical services as a whole, and in research in particular. The medical services, though conceived on a central plan, have an endless variety of administrative organs. Each of the autonomous republics controls its own services, which supplement those of the Union. Moreover, the municipalities, different industrial undertakings, collective farms, and many other labour organizations have services of their own, again supplementing those generally available. Soviet medicine is therefore a national medical service in its widest sense rather than a State medical service; its distinctive feature is its stress on preventive treatment.

The organization of research facilities is essentially parallel to those of the health services. Not all research institutes are under the control of the Commissariat of Health of the U.S.S.R. The newly established Academy of Medicine, the successor to the Gorky Institute of Experimental Medicine (Viem), controls a large number, and there are also institutes controlled by the governments of the autonomous republics. Furthermore, the medical schools and the universities play a significant part in medical research, so that there is no lack of research facilities or of variety of opportunity and service. Though there is intensive specialization, rigid departmentalization does not appear to be prominent; if anything, the opposite applies. This is apparent from such typical institutes in Moscow as those devoted to neurology, neuro-surgery, occupational diseases and ophthalmology. Each of these institutes consists of a large clinical unit balanced by well-equipped clinical and research laboratories. While these institutes employ many full-time laboratory research workers, they also have many others with both clinical and laboratory duties. Planned research, as it is understood in these institutes, consists of the co-ordinated activities of different workers approaching an agreed problem from their own special angle. The close contact that an institute and its planned work makes possible ensures that laboratory workers are fully acquainted with clinical needs, while the clinicians know the possibilities and limitations of the laboratories. Though working in a team, the individual worker does not lose his identity, as is obvious from the publications in the journals, which are not more frequently than elsewhere collective reports. While of necessity the bulk of the research in a clinical speciality is concentrated in the institutes exclusively devoted to it, all clinical institutes are broadly planned and have many special departments. Thus impressive work in ophthalmology was proceeding at the Institutes of Neurology, Neuro-Surgery and Occupational Diseases, and no doubt in other institutes too, in addition to the Institute of Ophthalmology. Some institutes are devoted exclusively to laboratory work in special fields, but these too do not appear to be narrowly conceived: at the Institute of Microbiology there was considerable work on pharmacology.

The team spirit and the organization of planned research probably ensure that in the Soviet Union more is known to research workers of unpublished work and its progress than is the rule elsewhere, and it is possible that publications as media for the dissemination of knowledge are relatively less important in the Soviet Union than they are in Britain. It is therefore all the more regrettable that there is so little personal contact between British workers and those of the Soviet Union.

Soviet medicine has grown rapidly, and in the course of its development has had to adapt itself to rapidly changing conditions. The training of medical men is as good an example as any of the empirical nature of much Soviet organization. No attempt is made to arrive at an ideal solution at any particular stage. When the need for numbers was urgent the training was not particularly exacting; and how urgent the need was is obvious from the fact that in 1913 there were less than 20,000 medical men in the Czarist Empire, whereas in the Soviet Union to-day there are about 150,000 and the number is still inadequate. As more physicians became available, the standard of training was persistently raised, and now has been fixed at a six years course. This is already operative in Moscow, and will become effective over the whole of the Union in the course of four years. This new level has rendered unnecessary such temporary makeshifts as specialization introduced at an early stage of the student's career. When the need was still pressing there was no general qualification in medicine; final-year students were trained for either public health activities, general practice, or children's diseases. While raising the standard of medical training, the Soviet authorities are still creating 'feldschers', relics of the old barber surgeons. They are given a practical training and are allotted much of the routine work of medicine, generally under supervision. In the course of time the 'feldscher' will no doubt disappear, but for the present his persistence is the price that has to be paid for the more intensive training of physicians.

It is the aim of Soviet educationists to produce 20,000 well-qualified medical men a year. The fifty-two medical schools at present available scarcely seem adequate for such numbers, but there is no shortage of candidates. Students for the medical schools are recruited from the secondary school population, and there are two systems of entrance. Those secondary school students who have a good record gain admission to the medical schools automatically; the remaining places are then filled by competitive examination from among the secondary school students whose record has not been so good. Stipends are paid throughout the student's career and they increase with each year of study. On qualification, students are expected to undertake three years service wherever the need is greatest; but many of those who have done well are expected to specialize immediately as clinicians or research workers. All who have given three years service are encouraged to "improve their qualifications", so that postgraduate study is a normal feature in the life of the Soviet physician. Soviet medicine has no fear about the standard and qualifications of its personnel.

A glance at Russian medical journals, and, still more, visits to hospitals and research institutes, show clearly that Soviet medicine is not 'practical' in the crude sense of the word. Though there is an ever-present need for personnel, and attention to the immense public health problems of the Soviet Union requires many routine workers, much of the work in the laboratories is of a highly abstract character. None the less, practical results are constantly sought. The immense flora and variety of soil conditions of the Soviet Union have been pressed into service. Systematic exploration of the pharmacological properties of the higher plants and soil bacteria is proceeding, while such institutes as that of balneology with its great variety of laboratories illustrates the use that Soviet physicians are making of the curative properties of springs and muds.

Although Russian workers have much to contribute to the rest of the world, they are borrowing freely from abroad, and, in some instances at any rate, have extensively developed work that was begun elsewhere and not carried to any conclusion. The production of lysozyme on a massive scale from a large variety of biological substances is an example. This achievement has been rather overshadowed by the coming of penicillin, but the Russian preparation of penicillin from *Penicillium crustosum* and their intensive exploration of the possibilities of producing synthetic penicillin illustrate once more that they not only borrow but also develop and improve on work from abroad. In the comity of civilized nations, Soviet medicine holds its place as an equal.

AGROCHEMISTRY

By Dr. E. M. CROWTHER
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RUSSIAN translations into English of the names of institutes and journals produce many uncouth phrases, such as "Chemisation of Socialist Agriculture" and others mentioned below, but occasionally they produce a word which we might well take over. Thus 'agrochemistry' describes fairly satisfactorily one of the halves into which our old science of agricultural chemistry is splitting up under the influence of increasing specialization. The subject covers crop nutrition and those branches of soil science concerned with soil fertility rather than soil formation and classification. The grand old man of Russian agrochemistry is D. N. Prianischnikow who, with a few other members of the Academy of Sciences, had received the highest Soviet award, Hero of Socialist Labour, a few days before our arrival. We were delighted to find him fitter and more lively in his eightieth year than when he last visited England in 1935 for the Third International Soil Congress at Oxford.

An outstanding feature of Russian agricultural science is the elaborate organization of team-work in a large number of institutes responsible to independent authorities. Considerable overlapping in programmes is not only allowed but also clearly encouraged. The necessary co-ordination is secured and a high standard of work maintained by requiring many research workers to divide their time between two or more institutes or colleges, and by giving a few overworked authorities responsibility for a broad group of problems in several institutes. Thus we saw one of Prianischnikow's teams at Dolgoprudnoye in the Gedroiz Institute of Fertilizers, Soil Management and Soil Science under the Lenin Academy of Agricultural Sciences, and another in the Department of Agrochemistry in the huge Timiriazev Academy of Agriculture, which has some sixty professors and 3,000 students. We also came across his pot-culture work in collaboration with the radioactivity section of the Institute for Geochemical Problems. Another example is afforded by the work of Prof. I. W. Tiurin on soil organic matter in the soil science departments of the University and the Forest Technical Academy at Leningrad and the Biochemistry Department of the Dokuchaiev Soil Institute at Moscow. Even Prof. Joffe, with all his other commitments in pure and applied physics, manages to find time to direct an admirable Institute of Physical Agronomy in Leningrad under the Lenin Academy of Agricultural Science. By means of his improved thermocouples, it was found that during August the night temperatures of potato leaves in the northern regions are often as much as 7° below those of the soil surface. This led to a new method of planting potatoes in wide high ridges across the direction of the prevailing wind, to transfer as much heat as possible from the soil to the leaves and so avoid late frost damage.

Prianischnikow has been checking his early work on nitrogen metabolism in plants and has confirmed that plants of all ages take up ammonium ions more rapidly than nitrate from dilute solutions of ammonium nitrate, though from unduly concentrated solutions nitrate may be taken up and ammonium excreted. In view of the acute shortage of nitrogenous fertilizers, which was manifest in all the crops we saw, Prianischnikow has great hopes of the benefits likely to accrue in the north from the rapid extension as a green manure crop of a frost-resistant Canadian strain of the blue garden lupin, *Lupinus polyphyllus*.

During the War, fertilizers could be spared only for a few industrial crops, such as cotton and irrigated sugar beet, but research on both the production and efficient use of fertilizers is well advanced. At Salikamsk there are larger reserves of potash than in Germany, and it is claimed that the U.S.S.R. now has larger reserves of phosphate than any other country. Until recently the only known deposits were low-grade rock phosphates and crystalline apatites, both unsuitable for making superphosphate. Brilliant work by Kazakov in the Institute for Fertilizers and Insecto-fungicides under the Commissariat for Heavy Industry has led to the discovery of vast deposits of high-grade rock phosphate in the Kara Tau region of Kazakstan. This discovery is also of considerable geological interest, for it was the outcome of a new theory of the formation of rock phosphate by precipitation from cold deep waters upwelling against a continental shelf.

Preparations are well advanced for using fertilizers on a vast scale. Thousands of field experiments have been conducted over a variety of crops, soils and regions, and individual collective farms are being mapped to show the best amounts and forms to use. Fertilizer consumption and crop yields should increase rapidly, especially in the leached soils of the centre and north, as soon as new factories and railways can be built.

The need for lime is still acute. About half the isolated limestone deposits are dolomitic, but recent work in the U.S.S.R., as in the United States and Great Britain, has shown that the old agricultural prejudice against this form is ill-founded. Indeed, it has been shown that some sensitive crops, such as serradella, lupins and potatoes, may safely receive full dressings of magnesian, though not of high-calcium, limestones.

Great importance is attached by the Mechanization Institute to a double plough in which a half-size plough precedes the usual digger plough. It is claimed that this buries turf and weeds more completely and avoids dead air spaces, and it was stated that no other type of plough is to be made.

Much work is being done on the difficult problem of analysing the production of tilth and the stability of soil aggregates. It will come as a shock to exponents of ley-farming in Britain to hear that several Russian workers hold that leys should not be grazed, at least for three years, lest trampling by stock should annul the granulating action of the grass roots.

(*To be continued*)

OBITUARIES

Major C. E. S. Phillips, O.B.E.

By the death of Charles Edmund Stanley Phillips on June 17, many will mourn the death of a very interesting personality.

Phillips was born on February 18, 1871, his father being Samuel E. Phillips, one of the founders of Johnson and Phillips, the firm which made some of the earliest electric marine cables. He was educated privately and studied, for a short time only, at the Central Technical College, South Kensington. It may be that it was owing to his rather unorthodox education that he was so versatile.

After the discovery of X-rays in 1895, Phillips devoted much time to the making of vacuum tubes and in studying their performance in his own laboratory at Shooters Hill. His friend, H. O. Mance (now Brigadier-General Sir Osborne Mance), who was working with him, has preserved some of Phillips's letters written to him early in 1896 describing his difficulties. In a letter dated May 4, 1896, Phillips says, "this afternoon I made a Röntgen tube myself but afterwards found the glass used was lead glass so gave it up as useless". In July of the same year he writes: "I've got an experimental vacuum tube nearly finished which takes to pieces and can be cleaned and exhausted. . . . There seems no doubt that the X-rays consist of rays having various different properties and are by no means homogeneous".

Phillips continued to experiment with vacuum tubes and published in 1901 a paper, which created a good deal of interest at the time, on the effects produced by a magnetic field upon the distribution of ions within a highly evacuated space (*Phil. Trans.*, A, **197**, 135; 1901). In 1908 he produced an electrical conducting glass (*Proc. Roy. Soc. Edin.*, 28, 627; 1908) from which the windows of electroscopes could be made. Unfortunately, the glass was never made commercially. In 1910 he delivered a discourse at the Royal Institution on the electrical and other properties of sand. In this he showed some striking and original experiments which might well be repeated.

Phillips was one of the founders of the Röntgen Society and read several papers before it. He served as its president in 1909. During 1914–17 he was in charge of the X-ray Department of the Royal Herbert Hospital, Woolwich, and during 1915–18 was physicist to the X-ray Committee of the War Office. Towards the end of 1915 he gave, at the 2nd London General Hospital, a course of lectures to the orderlies of X-ray departments on the physics of X-rays, Dr. Russell Reynolds dealing with the medical side of the subject. These courses of lectures may well be regarded as the initiation of the movement for training radiographers. Phillips was much concerned at the need of protection for those working with X-rays, and served as a member of the Inter-Services X-ray Advisory Committee from its inception until its dissolution in 1939. He was appointed brevet major (on reserve to the 5th Battalion Royal West Kent Regiment) in 1918 and received the O.B.E. for his services.

Phillips was one of the founders of the British Institute of Radiology and was its president during 1930–31. He was for some time lecturer on radiology at University College, London, and was also physicist to the Royal Cancer Hospital.

In 1909 Phillips suggested the use of a trace of radium with zinc sulphide for luminizing the dials of night-marching compasses, and the first model made by him is preserved in the Science Museum at South Kensington. It is unnecessary to stress the importance of this invention.

Phillips was one of the founder fellows of the Institute of Physics, and, if he was not the first to suggest the formation of the Institute, played the leading part in its formation in 1918. He was a member of the first Board and, except for one brief interval, served on it until his death; he had been treasurer since 1925. From 1929 until a few weeks before his death he was also honorary secretary of the Royal Institution.

Phillips was an excellent violinist and enjoyed playing on his Stradivari violin. In a discourse given before the Royal Institution in May 1935, he showed how he had tried to elucidate the secrets of the tone of the violins made by the old masters. He was also a good amateur artist; his portrait of Sir William Bragg now hangs on the walls of the Royal Institution. He gave great pleasure to many friends by his facility in depicting them in caricature. He was a delightful companion with a keen appreciation of a practical joke, especially if it had a scientific background. He was at his best at the dinners of the Physical Society Club, of which he was one of the founders.

In 1903 he married Winifred, the elder daughter of the late Mr. John Baines. R. S. Whipple.

Mr. R. W. F. Harrison and Mr. A. G. Hastings White, C.B.E.

The association of the main work of a lifetime with the affairs and traditions of an old foundation is, happily, not yet rare. With the recent deaths of Mr. Robert William Frederick Harrison (July 15) and Mr. Alfred George Hastings White (July 8), at the ripe ages of eighty-seven and eighty-six years, the Royal Society has lost links with a bygone generation. Both had made its interests the centre of their own and had become steeped in its traditions, though the manners of their service and the periods over which it was rendered differed widely.

Mr. Harrison was already a man of thirty-eight, with varied experience behind him, when he became assistant secretary; and when he retired, early in 1920, he had held the position for just under twenty-four years. He was born in the house of the London Library, St. James's Square, where his father was librarian. After schooling at Westminster he studied for and was called to the Bar, but never practised. At the age of twenty-four, in 1882, he became secretary to the Royal Society Committee arranging for observation of the transit of Venus. Then, after acting for a period as tutor to Lord Porchester, who became Earl of Carnarvon, he was secretary to the City and Guilds of London Institute and to the Art Union of London.

Fellows of the Royal Society still living will remember Harrison's entry there in 1896, when he succeeded the late Mr. Herbert Rix as the last assistant secretary to occupy the residential quarters designed for such use on the top floor of the Society's apartments. He did important services to the Society in a number of directions. The publication of the annual Year Book was due to him, he did essential work for the first three editions of the historical "Record of the Royal Society", and the attendance of the assistant secretary as minute-clerk at the Council meetings appears to have been an innovation due to him.

In those days of relative ease and leisure in the Society's affairs, Harrison, a man of rather striking personality, found time for a number of other interests. He was known as a violinist and a yachtsman. The article on the violin in the "Encyclopædia Britannica" (11th edition) was written by him, and, being a skilful carpenter, he converted a twenty-foot open boat into a yacht largely with his own hands, details of the structure, it is said, being actually fabricated in the Royal Society's rooms.

Harrison's knowledge of the Society's traditions grew with his devotion to its interests, and the devotion, as the years went by, not unnaturally took a rather possessive tinge in a man of his masterful temperament. Officers whose own experience had grown with his were easily tolerant of this, but those who had to face the changes and developments which came into view with the end of the War in 1919 doubted Harrison's adaptability to the new needs. He retired on pension, and the Council recorded the thanks due to him for his conspicuous zeal and devotion to the Society's interests; but he had not gone willingly, and he kept aloof for his remaining twenty-six years from the Society which he had so well served in his middle period.

Mr. White was a man of a very different style and temperament, whose services to the Royal Society extended over no less than seventy-three years in all. His father, Henry White, had graduated at Cambridge and qualified in medicine, but never practised, his interests being predominantly those of a scholar. Henry White had joined the staff of the Society in 1868 to edit its "Catalogue of Scientific Papers", and later undertook also the catalogue of all the books and papers in the Society's own library. By 1872 he needed help with these undertakings; and having perhaps lost faith in the value of a formal higher education, or lacking the means to provide it for his son, he took the boy Alfred at the age of thirteen from the North London Collegiate School and brought him as his assistant into the library of the Royal Society. It is of interest to remember that the Society was then still accommodated in old Burlington House, and did not move to its present quarters until a year later. It was in the Society's library, then, under his father's tuition and by dint of his own eager and unending diligence, that Alfred Hastings White obtained all that he ever had of secondary or higher education. He attained, in fact, to a fine though unusual scholarship, including a quite remarkable reader's command of languages, both ancient and modern, and a wide and detailed knowledge of the library in which he worked and which was to be for so many years under his care. Henry White died suddenly in the Society's meeting room in 1880, leaving his son, a young man of twenty-one, to be responsible alone for completing the catalogue of the library which was published in the following year.

In 1885 the Council appointed A. H. White "to assist the Secretaries in the work of publication and the work of the library pertaining to the office of Assistant Librarian", and this was his official position until he retired in 1930. In those forty-five years he had become the friend and helper of every fellow of the Society who used or took interest in the library, and of many whose papers he saw through the press. He had none of the system or technique of modern librarianship; but Nature, assisted, perhaps, by the manner of his training, had given him an extraordinary faculty of memory. References which he had once traced—shelf, volume and page—he seemed to retain indefinitely without written record and to produce at will. His unique knowledge of the library which he loved and cherished, his accumulating fund of varied information and bookish gossip, were almost too readily available to any fellow or visitor who showed interest. For many years he continued also to carry out the duty of formal editing and proof correction of all the Society's scientific publications, in addition to his library duties, and he retained this for the biological papers until he retired.

When he retired in 1930, after fifty-eight years of service, White was full of gratitude for the arrangement made, and anxious only for assurance that he would still have access to his beloved library. The Society gave him this with the appointment of 'consulting librarian', which he retained until his death, and only the failure of his eyesight restricted his enjoyment of it.

White is known to have contributed items to such publications as *Notes and Queries*, and sets of questions on general knowledge to the more popular Press, but he published little under his own name. The best-known publication attributable to him was his scholarly edition, which appeared in 1936, of William Stukeley's "Memoirs of Isaac Newton", the original manuscript of which had come into his possession. This treasure he later presented to the Society's library—a last token of a lifetime's affection.

To the memories of both these old friends, in such different ways its devoted servants, the Royal Society pays grateful tribute. H. H. DALE.

WE regret to announce the following deaths:

Mr. R. C. Porter, for thirty-seven years lecturer in the Department of Mechanical Engineering of the University of Birmingham, on July 28, aged seventy-three.

Mr. L. G. S. Reynolds, C.B., C.B.E., formerly Assistant Under-Secretary of State, Air Ministry, and since 1944 secretary to the Standing Commission on Museums and Galleries, on June 29.

Prof. Gustav Senn-Bernoulli, professor of botany in the University of Basel, on July 10, aged seventy,

NEWS and VIEWS

New President of the Academy of Sciences of the U.S.S.R.: Academician Sergei Vavilov

On July 17, Sergei Vavilov was elected as the new president of the Academy of Sciences of the U.S.S.R., in succession to Vladimir Komarov, the botanist. Vavilov, who is a comparatively young man—he graduated in 1914—is one of the leading physicists in the U.S.S.R.: he is director of the Lebedev Institute of Physics, named after his former teacher, and directs the research at the State Institute of Optics. His own work has been mainly in various branches of the science of light. On the more academic side he has carried out important researches in the field of luminescence and fluorescence, having not only put forward a theory of luminescence of solutions but also developed a method of analysis, based on luminescence, which is being widely used in the U.S.S.R. On the applied side he has done much to develop in the U.S.S.R. the fluorescent discharge lamps for domestic and factory lighting which are now becoming so popular in Great Britain and the United States. Vavilov has also carried out distinguished work on the influence of the quantum nature of light on vision and on physiological optics in general. Reference to his active interest in the history of science, and in particular to his studies on Newton, is made in the article by Prof. E. N. da C. Andrade on the recent visit of British men of science as guests of the Academy of Sciences, which appears on p. 223 of this issue. In the jubilee celebrations of the Academy, Vavilov played an active part, and his British colleagues who met him will be delighted to hear of the great honour that has accrued to him.

In addition to his distinguished and varied scientific experience, Vavilov is well acquainted with the tasks of general administration. He is a member of the Supreme Soviet of the Russian Federation, to which he was elected in 1938, and his services as a scientific worker and as a man of affairs have been recognized by the award of the Stalin Prize, the highest scientific distinction in the U.S.S.R., and the Order of the Red Banner of Labour and the Order of Lenin, which are very high distinctions. Vavilov is thus accustomed to solving both difficult scientific problems and wide problems of general organization and administration and is, in general, admirably fitted by temperament and training for the very important position that he is now to fill.

Chair of Botany at Leeds: Dr. Irene Manton

With the appointment of Dr. Irene Manton, at present lecturer in botany in the University of Manchester, to the chair of botany in Leeds, in succession to the late Prof. J. H. Priestley, the Leeds Department may be expected to maintain its record of scholarship and vigorous research activity. Although Dr. Manton's published work lies chiefly in the sphere of cytology, her extended studentship—Cambridge, with additional courses pursued in Switzerland and Spain—her subsequent tenure of postgraduate studentships (the Ethel Sargant and Yarrow) in Sweden, Germany, Cambridge and the Royal Botanic Garden, Kew, and further collecting journeys to France, the Mediterranean and Egypt, entitle her to be regarded as a botanist of wide general experience. This, together with her long teaching experience at Manchester (1930–45) and her skill as a cytologist will, without doubt, be seen to advantage as the Leeds Department develops under her guidance.

Dr. Manton's earlier work includes contributions to the cytological analysis of evolution. More recently, in collaboration with members of the staff of the National Institute for Medical Research, she has developed new technical methods whereby ultra-violet microscopy can be applied to problems of chromosome structure and in the resolution of nuclear problems, where the minute size of the objects under investigation has hitherto proved an insurmountable difficulty. This work, together with a comprehensive cytological survey of the Pteridophyta which is now approaching completion, will undoubtedly constitute a substantial contribution to botanical science.

Chair of Chemistry at University College, Dublin: Appointment of Dr. T. S. Wheeler

The Senate of the National University of Ireland has appointed Dr. T. S. Wheeler to the chair of chemistry in University College, Dublin, in succession to the late Prof. T. J. Nolan. Dr. Wheeler was educated at the Royal College of Science for Ireland, and served on the staff of the Royal Technical College, Glasgow (1920–21), and as a research chemist at the Royal Naval Cordite Factory, and at the Research Department, Woolwich. In 1928 he joined the staff of the Winnington Research Laboratories of Imperial Chemical Industries, Ltd., and was concerned with the investigation of a number of processes involving gas reactions at high temperatures and pressures. In 1931 he went to India as principal and professor of organic chemistry, Royal Institute of Science, Bombay. He took an active part in the scientific life of India, being for some time dean of the Faculty of Science of the University of Bombay, and a foundation fellow (sometime a vice-president) of the National Institute of Sciences of India. His research work in Bombay dealt mainly with the chemistry of chalkones and flavones. In 1938 Dr. Wheeler returned to Ireland as State chemist. He has been for the last seven years head of the State Laboratory, and has served on the Eire Emergency Research Bureau. Though primarily interested in organic chemistry, Dr. Wheeler has also published work on the theory of liquids. In this age of specialization Dr. Wheeler has had a varied career, typified by the fact that he is one of the few holding the three professional qualifications of fellowship of the Royal Institute of Chemistry and of the Institute of Physics and membership of the Institution of Chemical Engineers.

American Chemical Society, New York Section: Dr. Cornelia T. Snell

Dr. Cornelia T. Snell, of Foster D. Snell, Inc., consulting chemists and chemical engineers of Brooklyn, N.Y., has been appointed chairman of the New York Section of the American Chemical Society. Dr. Snell, who succeeds Dr. Ross A. Baker, professor of chemistry in the School of Business and Civic Administration of the College of the City of New York, is the first woman to preside over the New York Section, which with 4,148 members is the largest of the Society's 106 local sections. She has been serving as chairman-elect of the Section and would have succeeded to the chairmanship in 1946 upon the expiration of Dr. Baker's term of office. Dr. Baker resigned to serve as civilian educational specialist at a U.S. Army university study centre in Europe.

Dr. Snell, a native of Binghamton, N.Y., has been active as teacher, research worker, author and leader in chemistry. She received the degree of bachelor of science from Syracuse University in 1919, and for the next two years taught mathematics in a high-school. Her career in chemistry began after her marriage to Dr. Foster D. Snell in 1921. She took undergraduate courses at Barnard College, and pursued graduate studies at Columbia University, from which she received the M.A. degree in 1925 and the Ph.D. in 1930. Dr. Snell became research assistant in the pediatric department of the Fifth Avenue Hospital, and then spent a short period in the pathology department of the College of Physicians and Surgeons, eventually joining the organization headed by her husband. Dr. Snell was secretary of the New York Section of the American Chemical Society during 1937–44, and is chairman of the Women's Service Committee of the American Chemical Society. She is the author, with Foster D. Snell, of "Colorimetric Methods of Analysis", in two volumes; "Chemicals of Commerce" and "Chemistry Made Easy", in four volumes.

Men of Science in the Modern State

In his speech at the closing plenary session of the Commonwealth and Empire Conference on Radio for Civil Aviation on August 20, Lord Winster, Minister of Civil Aviation, said that among several myths which have been destroyed during the War has been that of the superiority of German men of science and of the degree of co-ordination which had been arrived at in Germany between science and industrial and war production. The course of the War showed not only that the United Nations have men of science second to none, but also that we have been far more successful in marrying their knowledge and their labours into the national war effort. Furthermore, it is now acknowledged that in future provision must be made in Britain for the training in its colleges and universities of far more scientific and technical workers than in the past, and that the pursuit of a scientific career must be made much more attractive in such matters as status and salary. These facts, Lord Winster said, are now recognized "and recognition will, I believe, be translated into action".

Lord Winster continued in a vein which will recall many an article in these columns. We have seen, he said, in the field of research what teamwork backed by unlimited funds can do. We have entered into a field in which the man of science will bring us knowledge which not merely enriches and facilitates the progress of the world but also determines the lines which progress shall take. If this is so we must alter our outlook upon the man of science; no longer can he be regarded as an interesting but unpractical individual. Even in the War of 1914–18 he did not achieve any very tangible recognition; in this War, thanks largely to Mr. Churchill, he has been coming into his own, and from now on he will be part of the warp and woof of the national life. In the future, the scientific worker by his discoveries will be determining the course the world will take. For this reason he must be brought out of the 'backroom' and brought in at the very highest level, not only for consultation about national affairs but also as regards the actual direction of those affairs.

Research in Animal Breeding and Genetics in Great Britain

As part of the survey which the Agricultural Research Council, in conjunction with the Agricultural Improvement Councils for England and Wales and Scotland, has been making of fields of research in which expansion is needed, special attention has been given to animal breeding and genetics as a subject of outstanding importance. After considering advice on developments in this field given by a special survey group, for which the American Government generously made available the services of Dr. R. T. Clark of Montana, and after consultation with the departments of agriculture, the Agricultural Research Council has appointed to its scientific staff Prof. R. G. White, professor of agriculture in the University College of North Wales, Bangor, and Dr. C. H. Waddington, of the Department of Zoology, University of Cambridge. Their first task will be to prepare a scheme for the creation of a national organization for research in animal breeding and genetics, covering the needs of Great Britain. Prof. White will be the director and Dr. Waddington will be chief geneticist.

It will be necessary for Prof. White and Dr. Waddington to investigate the systems adopted in other countries for the development of research in this field, so that a complete scheme cannot be ready for some time, though certain investigations of a statistical and fundamental character can be started in the near future. It cannot, of course, be indicated at present what centre or centres will be chosen for the development of research. The Council is, however, anxious that in any new developments full advantage should be taken of the experience of the Institute of Animal Genetics at the University of Edinburgh, which for so long has contributed to knowledge of these subjects and has been the centre of postgraduate training for workers from many countries. Similarly, it is the Council's intention, by close co-operation with practical breeders and the representatives of the agricultural industry throughout Great Britain, as well as with Milk Marketing Boards and other interested organizations, that arrangements shall be made whereby records are kept in such a form as to give the greatest measure of assistance to research workers in the new organization, and to be of real value in guiding the improvement of livestock. Research on such slow-breeding animals as farm stock must necessarily be lengthy, and results which can be applied with confidence in breeding practice cannot, therefore, be expected to emerge quickly.

International Co-operation in Social and Economic Fields

A pamphlet, "The New I.L.O", issued by the British Association for Labour Legislation, with an introduction by Barbara Ward, considers the position of the International Labour Organisation in relation to the Economic and Social Council of the Dumbarton Oaks plan, with the object of stimulating discussion on the planning of international co-operation in social and economic matters. Reviewing the past experience of the International Labour Organisation, the pamphlet is critical of the tripartite structure and questions the value of representation of employers except on the managerial or technical basis. A government should be the representative of the community as a whole, but governments should admit the workers also to the discussion of economic as well as of social problems, primarily to provide technical and constructive advice. In view of the clash and overlapping between general economic and social questions, the pamphlet appears to be dubious as to the continued existence of the International Labour Organisation as an entity, though this is not made clear. It is suggested, however, that the whole of the positive functions of the Economic and Social Council of the Dumbarton Oaks plan for constructing peace, as distinct from preventing war, should be discharged by bodies corresponding to those set up in 1918—an assembly, or conference, a council or governing body, and a secretariat or office, with committees to provide technical advice as required. The council would include representatives of the workers as well as governments and would take the place of the governing body of the International Labour Organisation. Its functions would include determining the agenda of the assembly, which itself would not be limited to government representatives. The secretariat would be divided into departments dealing, for example, with conditions of labour, with economic problems, with health and housing, with dependent territories and so forth, but with close inter-departmental relations. This plan would telescope the constructive functions of the old League of Nations secretariat and those of the International Labour Office, while employers or managers would find their place along with other professional men in the special committees created to advise on technical and practical issues. Although the Dumbarton Oaks plan is now, of course, submerged in the United Nations Charter, this pamphlet provides useful material for careful consideration.

Religion and Science

The conventional "conflict between religion and science" has concerned itself with questions which are not of themselves fundamental, and which are consequently incapable, as they stand, of any solution, as their perpetual recurrence indicates. The truth is, in Prof. H. Dingle's view, "that most of us have two different, and largely incompatible, attitudes towards what is essentially a homogeneous body of experience, and that we are, in the main, unconscious of this" ("Science and Religion." Modern Pamphlets on Religion, Life and Thought, No. 5. Union of Modern Free Churchmen, 92 Blake Road, London, N.11. 6*d*.). Both scientific and religious interpretations, in spite of their divergence from one another, are "attempts to interpret experience in rational terms". Their difference lies in their being concerned, in the main, with different kinds of experience, so that the interpretations which in either case seem most suitable are different. The scientific descriptions of the world are most appropriate for the particular limited fields of experience with which the respective sciences deal. The religious descriptions are those most appropriate for the different but also limited fields of experience with which religions deal. As knowledge grows, it may be expected that the two descriptions "will develop and ultimately coalesce into a single description capable of expressing all experience"; though we need not expect this ultimate description "to be identical with, or even greatly to resemble, any of the descriptions we can at present give"; and we shall therefore regard without concern any incompatibility between religious and scientific thought to-day. For we must recognize that the time has not yet come when we can construct a single comprehensive world-picture that will interpret all experience. We must be content with partial pictures, each limited to the experiences which provide its justification.

The Night Sky in September

New moon occurs on Sept. 6d. 13h. 43m. U.T. and full moon on Sept. 21d. 20h. 46m. The following conjunctions with the moon take place: Sept. 2d. 11h., Saturn 1° S.; Sept. 3d. 11h., Venus 3° S.; Sept. 4d. 22h., Mercury 4° S.; Sept. 8d. 00h., Jupiter 4° S.; Sept. 29d. 00h., Mars 0·2° S.; Sept. 29d. 20h., Saturn 2° S. In addition to these conjunctions with the moon, the following conjunctions take place: Sept. 9d. 12h., Mercury in conjunction with Regulus, Mercury 0·3° N.; Sept. 23d. 19h., Venus in conjunction with Regulus, Venus 0·4° N. Occultation of μ Gem (*D*). takes place on Sept. 1d. 3h. 39·2m., and of 147 B Aries (*R*) on Sept. 25d. 3h. 10·4m. On Sept. 29 there is a grazing occultation of 44 Gem. Mercury can be seen in the morning hours, rising at 3h. 51m., 4h. 13m. and 5h. 47m. at the beginning, middle and end of the month, respectively. The planet is at its greatest westerly elongation on Sept. 6. Venus can be seen in the morning hours, rising at 1h. 51m., 2h. 28m. and 3h. 07m. at the beginning, middle and end of the month respectively. Mars rises at 22h. 42m. on Sept. 1 and at 22h. 10m. on Sept. 30. Jupiter is unfavourably placed for observation. Saturn rises at 0h. 52m. at the beginning and at 23h. 12m. at the end of the month. Autumn equinox commences on Sept. 23d. 10h.

Announcements

A Conference on "Friedel-Crafts Catalysts and Polymerization" has been arranged at the Department of Chemistry, University of Manchester, to be held on September 15. Those taking part include Prof. M. Polanyi (Manchester), Dr. P. H. Sykes (I.C.I. Billingham), Prof. H. W. Melville (Aberdeen) and Prof. M. G. Evans (Leeds). Notification of attendance should reach Prof. Polanyi by September 1.

The annual conference of the Association of Special Libraries and Information Bureaux will be held at the Portland Hall, London, W.C.1, during September 15–16. The opening address will be delivered by Prof. J. D. Bernal, who will speak on the information service as an essential factor in the progress of science; there will also be a symposium on "Links with the U.S.A." and a discussion on the effects on education, research and cultural relations of the shortage of books. Application forms can be obtained from the office of the Association, 52 Bloomsbury Street, London, W.C.1.

The National Institute of Agricultural Engineering intends to recommence publication of the *Agricultural Engineering Record*, as a quarterly journal dealing with developments in the mechanization of agriculture. Publication was begun in 1940, but ceased after the first number because of war-time difficulties. The *Record* will contain accounts of the research and development work carried out at the Institute; and it is hoped that other workers in this field will also contribute to its pages. A new feature will be the inclusion of summaries of test reports issued by the Institute, when these have a general interest. The first number will appear in September, and thereafter on January 1, April 1, July 1 and October 1 each year (1*s*. per copy, or 4*s*. 4*d*. per year, post paid; subscriptions to the Secretary, National Institution of Agricultural Engineering, Askham Bryan, York; or to H.M. Stationery Office, York House, Kingsway, W.C.2).

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Further Observations on the 'Incomplete' or 'Blocking' *Rh* Antibody

WE would like to record a few more observations n the 'incomplete' or 'blocking' *Rh* antibody recently ound in human serum[1,2]. 'Incomplete' antibody iffered from other *Rh* antibodies in that it failed to gglutinate red cells carrying the equivalent antigen. did, however, block this antigen, so that subequent exposure to the homologous 'complete' or gglutinating antibody failed to result in the agglutnation of the treated cells. The antigen involved is hat called *D* in Fisher's notation[1]; other *Rh* antigens nd the antigens *A*,*B*, *M*,*N* and *P* are not blocked y this antibody.

Since the earlier communication, it has been found hat the 'incomplete' antibody is more thermostable han the 'complete' agglutinin. Heat just insufficient o cause coagulation of a serum (65°–70° C. for 5–10 minutes) will destroy all detectable *Rh* agglutinin but eave the 'incomplete' antibody apparently unchanged n quality or quantity. Heating a serum containing only *Rh* agglutinins has not so far produced 'incomlete' antibody. This greater thermostability of ncomplete' antibody compared with agglutinin has also been reported by Diamond and Abelson[3].

An early observation that, when antigen was added o a mixture of 'complete' and 'incomplete' antibody, he latter was absorbed preferentially shows that the incomplete' antibody is the more strongly adsorbed of the two. It was found that the 'incomplete' antibody would not pass through a collodion ultrailter, of a type used for osmotic pressure measurements and known to be impermeable to proteins of molecular weight 30,000 if not less. The filter was a semi-permeable membrane prepared from a solution of collodion in equal volumes of ether and alcohol, by Mr. H. Gutfreund of the Biochemistry Department, Cambridge, after the method of Adair[4]. Two thirds the volume of the serum was filtered using a pressure of one atmosphere. The ultra-filtrate contained no 'incomplete' antibody, which was still present in the ultra-residue. Thus it would seem likely that the incomplete antibody is of a protein nature.

We thought we might get some further information about the 'incomplete' antibody by noting the change n surface charge of red blood cells after being exposed to serum containing this antibody. The measurements were made using a cylindrical microelectrophoresis cell.

The suspending fluid for the blood cells was the standard saline phosphate solution used by Furchgott and Ponder[5], in their electrophoretic studies on human red cells. This solution was made up of nine parts of a 1 per cent solution of sodium chloride ('Analar'), and one part $M/15$ phosphate buffer at pH 7·38. This gave a solution having a final pH of 7·24 at 18° C., an ionic strength of 0·172, and a specific resistance of 70·13 ohms at 18° C. The readings were taken at room temperature (17–18·5° C.) at the 'stationary level' of the micro-electrophoretic cell. The specific resistance of the solution over this temperature range had been previously determined. The red blood cells used were of the genotype Rh_2rh, having the *Rh* antigenic structure $\frac{cDE}{cde}$ (Fisher[1]). These were obtained just before use by ear prick, suspended in saline and washed three times. Saline was then added to give a 0·5 per cent suspension. 0·4 c.c. quantities of this suspension were then treated as follows: (1) no further treatment; (2) 0·4 c.c. saline added; (3) 0·4 c.c. added of human serum (group *AB*), which contained no demonstrable *iso*-agglutinins of any kind; (4) 0·4 c.c. added of human serum (of the type now called by Wiener anti-*Rh'*) containing the incomplete antibody corresponding to the *D* antigen, but containing no agglutinin for Rh_2rh cells. (On removal of the 'incomplete' antibody from this serum, the absence of any masked corresponding agglutinin could be disclosed); (5) 0·4 c.c. added of human anti-*Rh* serum, of the type called anti-Rh_0, which contained only the agglutinin corresponding to the antigen *D*. All the sera had been previously heated to 56° C. for half an hour. Tubes 2–5 were incubated for half an hour at 37° C. The tubes were then centrifuged and the supernatant fluid replaced by an equal volume of saline. On resuspension, agglutination was present only in tube 5. The cells were then washed twice with saline and resuspended in the standard saline phosphate solution to give a 0·01 per cent suspension.

The electrophoretic migration of these five suspensions was then measured using a current of 3 milliamp., which gave a field strength of 5·85 volts/cm.

The cells were found to have the following mobilities (towards the anode):

(1) $0{\cdot}91_4$ μ/sec./volt/cm. (cells untreated).
(2) $0{\cdot}91_4$,, ,, (cells treated with saline).
(3) $0{\cdot}90_5$,, ,, (cells treated with 'inert' human serum).
(4) $0{\cdot}85_0$,, ,, (cells treated with 'incomplete' antibody).
(5) $0{\cdot}85_1$,, ,, (cells treated with agglutinin).

These results are only qualitative as they are the effect produced by the undiluted sera, and are not based on any definite sensitizing dose, which in the case of the 'incomplete' antibody is difficult to express. However, it would seem justifiable to conclude that there would have been ample sensitizing substances, in both the undiluted sera, to saturate all the homologous receptors on the blood cells: for the agglutinating serum had a titre of 1/128, and the serum containing the 'incomplete' antibody, in a dilution of 1/8, was capable of blocking the action of a strong agglutinating serum.

The interesting fact was that the effect on the charge of the red blood cells produced by the serum containing the 'incomplete' antibody was of the same order as that produced on the charge of the cells by the serum containing the 'complete' agglutinin. Also the cells sensitized with the agglutinin and the cells 'sensitized' with the 'incomplete' antibody had exactly the same charge; yet the former agglutinated and the latter did not. This shows definitely that the surface charge is not the one and only factor causing the actual agglutination (second stage).

The above experiments seem to show that the 'incomplete' antibody is probably of a protein nature, although remarkably thermostable. It appears to act in the same way as a true agglutinin, sensitizing the cell; but differing in that it lacks something in its structure which is essential for the agglutination of the sensitized cells.

We should especially like to express our sincere thanks to Dr. A. E. Alexander, of the Colloid Science Department, Cambridge, for his continued help and

advice in the microelectrophoretic studies recorded in this paper.

R. R. A. COOMBS.
R. R. RACE.

Department of Pathology,
University of Cambridge,
and Medical Research Council,
Emergency Blood Transfusion Service.
June 18.

[1] Race, *Nature*, **153**, 771 (1944).

[2] Wiener, *Proc. Soc. Exp. Biol. and Med.*, **56**, 173 (1944).

[3] Diamond and Abelson, *J. Clin. Invest.*, **24**, 1, 122 (1945).

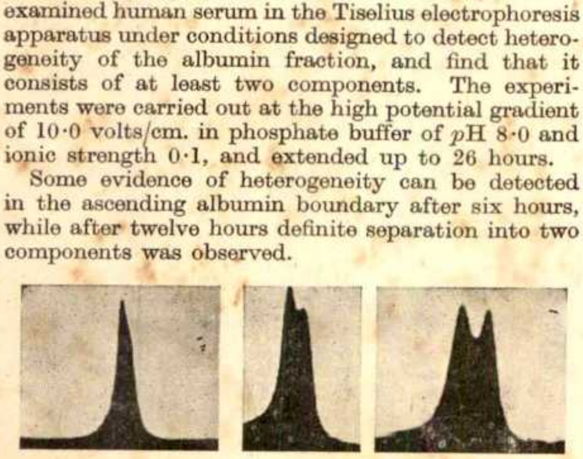
[4] Adair, *Proc. Roy. Soc.*, A, **108**, 627 (1925).

[5] Furchgott and Ponder, *J. Gen. Physiol.*, **24**, 447 (1941).

Heterogeneity of Human Serum Albumin

THE existence of more than one serum albumin in the horse has been demonstrated by chemical fractionation by several workers. We have now examined human serum in the Tiselius electrophoresis apparatus under conditions designed to detect heterogeneity of the albumin fraction, and find that it consists of at least two components. The experiments were carried out at the high potential gradient of 10·0 volts/cm. in phosphate buffer of pH 8·0 and ionic strength 0·1, and extended up to 26 hours.

Some evidence of heterogeneity can be detected in the ascending albumin boundary after six hours, while after twelve hours definite separation into two components was observed.



6 hr. 12 hr. 22 hr.

ELECTROPHORETIC MIGRATION OF HUMAN SERUM ALBUMINS AT pH 8·0. SERUM DILUTED 1 : 2 WITH BUFFER. PHILPOT-SVENSSON OPTICAL SYSTEM.

We have also observed a small third peak migrating faster than the albumins. This is associated with pigment and lipoids. It is not yet possible to say whether it represents a true protein component.

The two albumin peaks have now been observed in all the five normal sera examined up to the present. The ratio of the mobilities of the two albumins is 1·01, and this value remains constant throughout the experiment.

Previous workers have reported only one albumin boundary at pH 8·0, although Luetscher[1] observed a complex pattern between pH 4 and 6. Moyer and Moyer[2] separated two albumins from horse serum by fractional crystallization and showed that the difference in electrophoretic mobilities was greatest at pH 8·0. The present observations show that human serum also contains at least two albumins, which have not previously been differentiated on account of the small difference in their mobilities.

We suggest that the faster component be termed A_1 and the slower A_2, pending their further characterization, on which we are now engaged.

H. HOCH.
C. J. O. R. MORRIS.

Hale Clinical Laboratory, and Endocrine Unit,
The London Hospital. June 2.

[1] Luetscher, J. A., *J. Amer. Chem. Soc.*, **61**, 2888 (1940).

[2] Moyer, L. S., and Moyer, E. Z., *J. Biol. Chem.*, **132**, 373 (1940).

An Antibiotic Substance in the Chine Water-chestnut, *Eleocharis tuberosa*

IN our search for the presence of antibiotic su stances in the higher plants used in China for fo or for drugs, we have examined the tubers of t waterchestnut, *Eleocharis tuberosa*.

The waterchestnuts, bought in the local mark were washed and crushed in a Carver laborato hydraulic press. In a typical experiment, 1,650 g of waterchestnuts yielded 300 ml. of a milky liqu with a slightly acid reaction (pH 6·3). This w neutralized with a few ml. of $N/10$ sodium hydroxi solution and the antibiotic action of the soluti was tested with the 'ring test' method of Heatle for penicillin. Positive results were obtained wi *Staphylococcus aureus*, *B. coli* and *Aerobacter aer genes*. *Bacillus graveolus* was found to be unaffect under the conditions of our experiments.

The active principle has not yet been extracte and concentration of the liquid extract has thus f been effected by a crude technique[2] because of la of a proper vacuum pump. The active substan is thermolabile, being destroyed when subjected a water-bath temperature of 95° C. for more th 10 minutes. It is not destroyed when kept at pH or pH 8 for at least 30 minutes. In slightly alkalin acid or neutral media, it is not extracted by ethe petroleum ether, chloroform, benzene, carbon sulphide, ethyl acetate, acetone, etc. It is not adsorb by the sample of animal charcoal which we used by kaolin. The activity of the solution appears to destroyed by ethyl alcohol. When the milky soluti is cleared of its protein and other substances with lea acetate, and the latter is removed with hydroge sulphide, the clear neutralized solution gives n activity.

The partially concentrated extract when added t *B. coli* in microrespirometer vessels of the Warbur type inhibited the respiration of the culture mo than 80 per cent after about ten hours.

For convenience, we shall designate the activ antibiotic principle in *Eleocharis tuberosa* as 'puchiin from the Chinese characters for *Eleocharis tuberos*

We are indebted to Dr. G. S. Fan of the Chin Blood Bank for his assistance in carrying out som of the tests on the antibiotic effects of puchiin.

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Utilization of Carotene from Oils

VARIATIONS in the growth-response of vitamin A deficient rats to carotene dissolved in different oil has been partly attributed to their linoleic aci content[1]. While trying to discover the causes of th variations, it was felt that it would be of interest t test this hypothesis by equalizing the intake of linolei acid. Rats depleted of vitamin A reserves on a low fat diet similar to that of Sherman[1] were divide into five groups and fed the supplements indicate in the accompanying table by a and b by means o calibrated droppers.

Group	No. of rats used	Supplements	Gain in wt. (gm.)		Pigment excreted (%)		
			5 wks.	7 wks.	Total	Non-carotene	Carotene
I	7	*a* : 3 μgm. β-carotene and 100 mgm. cottonseed oil *b* : 100 mgm. cottonseed oil	25	31	40·5	24·0	16·5
II A	6	*a* : 3 μgm. β-carotene and 100 mgm. arachis oil *b* : 100 mgm. arachis oil	24	32	—	—	—
II B	6	*a* : 3 μgm. β-carotene and 100 mgm. arachis oil *b* : 80 mgm. ethyl linoleate and 20 mgm. arachis oil	24	30	34·2	17·1	17·1
III A	6	*a* : 3 μgm. β-carotene and 100 mgm. coco-nut oil *b* : 100 mgm. coco-nut oil	17	22	26·1	16·2	9·9
III B	7	*a* : 3 μgm. β-carotene and 100 mgm. coco-nut oil *b* : 100 mgm. ethyl linoleate	18	23	23·2	14·6	8·6

The supplements *a* and *b* were fed on alternate days o overcome the antagonism between carotene and noleate[1]. The oils were free from carotene, since ontrol rats receiving 500 mgm. of each in their diet ontinued to decline in weight and died. Since cotton seed oil contains 48 per cent, arachis oil 21 per cent and coco-nut oil 2 per cent approximately of linoleic acid[2], the total linoleic acid intake of rats in groups I, I *B* and III *B* on two consecutive days was almost he same. The ethyl linoleate was kindly prepared by Mr. P. R. Aiyar from sesame oil and had an iodine value 165.

The growth-response in coco-nut oil was much less than in arachis or cottonseed oils. The latter were equally efficient in spite of the wide variation in linoleic acid content. Further, increase in the intake of linoleic acid did not improve the response. It appears that the causes for the variations in response have to be sought elsewhere.

Ramasarma and Hakim[3] reported that rats excreted carotene even when it was administered at the level used in biological assays. Analysis of the fæces of the different groups of rats, collected for a number of days during the experimental period, confirmed their results, and showed that differences in fæcal excretion were too small to explain the variations in growth-response. The non-carotene pigment in the fæces could be separated from the carotene by chromatographic adsorption on a column of Brockman's alumina. The necessary correction was applied by determining the pigment excreted on a carotene-free diet.

The response to carotene has been shown to be improved by vitamin E (tocopherol)[4]. The tocopherol contents of the cottonseed, arachis and coco-nut oils determined by a modification of Moore's[5] procedure were 260, 286 and 0 gm. per gm. respectively. The utilization of carotene, therefore, appears to depend on the tocopherol content. A similar hypothesis has been put forward independently by Guggenheim[6], and experiments are in progress here to test this theory. The higher excretion of carotene with cottonseed and arachis oils may be explained by the antioxidative action of tocopherol in the gastro-intestinal tract. Incidentally, it was confirmed that no loss of tocopherol occurred during the saponification of the oil with alkali in the presence of pyrogallol. The details of these investigations will be published elsewhere.

I am grateful to Prof. V. Subrahmanyan for his interest in the work, and to the Lady Tata Memorial Trust for the award of a scholarship.

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Control of Internal Boll Rot of the Cotton Plant, caused by Insect Punctures (*Dysdercus* sp.), through Selection of Resistant Strains

One of the main problems related to cotton production in the irrigated valleys of the northern coastal part of Peru is connected with damage to the crop produced by the cotton stainer (*Dysdercus ruficollis*, L.), which in some years causes a loss of many million soles (1 sol = 1*s*. 1¾*d*. nominal value). The cotton crops of the valleys of Pativilca, Supe, Huarmey, Casma, Santa and Piura-Chira are the most affected annually by the "Arrebiatado" insect.

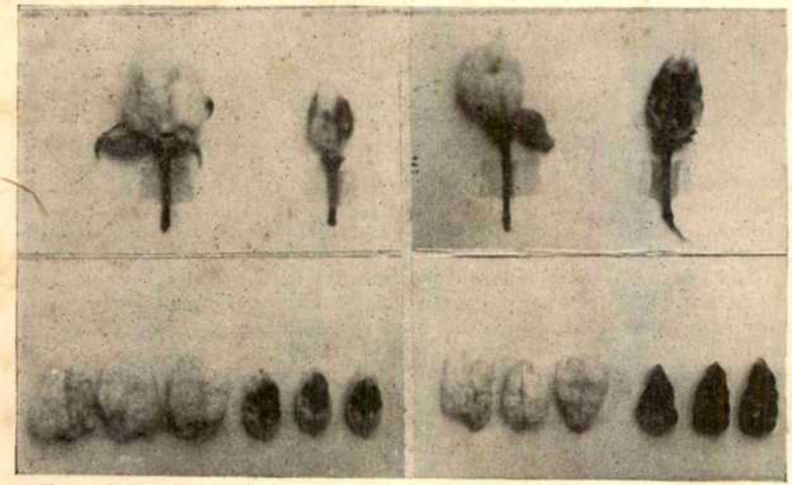
The known methods of control for cotton stainer damage, such as the strict observation of the time of planting and picking, in order to have a period of clean fields during the year, or the destruction of host plants (*Sida panniculata*, *Malachra* sp., and other Malvaceæ), the trapping of insects (a method scarcely used in Peru), or the use of special insecticides like "Babbini", recently developed in this country have had only partial success. Except for the Piura-Chira valleys, where the strict observation of time of planting and picking has led to very encouraging results, there is not known at present a method which will protect cotton plants against that pest.

Following the very interesting results obtained in the Belgian Congo by Dr. R. L. Steyaert[1], we submitted for the approval of the superintendent on February 8, 1945, "A project of phytotechnical investigations concerning the selection of Tangüis cotton strains resistant to the internal boll rot caused by the punctures of the arrebiatado (*Dysdercus ruficollis*, L.) insect". After approval of the project, the investigation started on April 13 in La Molina Agricultural Experiment Station.

The preliminary work dealt with the microorganism found in rotten bolls, naturally infected in the field, through the cotton stainer punctures, and was conducted by the Plant Pathology Service. Isolations from internal diseased bolls and cultures were made from the following micro-organism: *Y*-1 = Bacteria sp.; *Y*-2 = a fungus not yet identified; *Y*-3 = *Alternaria* sp.; *Y*-4 = *Acremonium* sp. Of these, *Y*-3 and *Y*-4 micro-organisms seem to be the most virulent. *Nematospora* sp. have not yet been found.

Then a series of inoculation tests were made on a total of 160 plants, selected from the best strains of the Plant Genetics Department. Four bolls from each plant were artificially infected, each one with a different micro-organism. The work was conducted in the laboratory after taking off the bolls from tagged plants and by submerging the peduncle of the bolls in water to keep them in good condition for an eight-day period. For inoculation, the technique of Dr. Steyaert was followed with minor modifications and proved to be very useful.

Examination of artificially inoculated cotton bolls after eight days showed in a large percentage that their contents were completely rotted. However, a few plants (twelve) from four strains showed 'resistance' to infection, especially the strain No. 16–38 (LM # 7–35 group), as demonstrated by the accompanying photographs.



Upper photographs: COTTON BOLLS ARTIFICIALLY INOCULATED WITH PURE CULTURES OF *Acremonium* SP. (LEFT) AND *Alternaria* (RIGHT). RESISTANT PLANT ON LEFT OF EACH PAIR. *Lower photographs:* LINT FROM BOLLS INOCULATED WITH PURE CULTURES OF *Acremonium* SP. (LEFT) AND *Alternaria* (RIGHT). RESISTANT PLANT ON LEFT OF EACH PAIR.

This investigation was begun on April 13 and continued until the end of the month. It will be continued in the next cotton season, toward the end of the year, with the four strains which were apparently 'resistant' to infection.

Comparing the results obtained by Dr. Steyaert, who worked with American varieties of cotton (*G. hirsutum*, L.) and those obtained by us, working with Peruvian varieties (*G. barbadense*, L., var. *peruvianum*, Cav.), it may be assumed that the latter varieties are genetically more 'resistant' to infection by fungus producing internal rot of the cotton bolls, transmitted by the "arrebiatado" punctures, than the former varieties.

A very interesting field of investigation appears to be opened up by the preliminary results mentioned here for the control by plant selection of cotton stainer damage.

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Inheritance and Acquired Characteristic

IN his recent book, "Habit and Heritage" (Kega Paul, 1944), Wood Jones has again directed attentio to the subject of hair-tracts in mammals with speci reference to direction of growth and scratching habi in hairdressing. He points out that in certain marsu ials, the habits of which have been observed an recorded in detail, the characteristic adult deviatio from the primitive cranio-caudal direction of th body pelage are already established in the pouc young. The inference to be drawn from the obviou correlation between direction of growth and scratchin habits of these species, and their predetermine appearance in the pouch-young, is that the modifie direction, originally induced through habit, has be come inherent in the genetic constitution during th course of evolution.

I am indebted to Mr. Albert Hochbaum, direct of the Experimental Duck Station at Delta, Manitob Canada, for directing my atte tion to the following analogou yet essentially different, case i ducks. All adult ducks have wel developed pterylæ (feather-tract and do their preening as system atically as mammals do thei scratching, running their bil along only certain defined lines o the contour plumage in conformit with the distribution of th pterylæ. Preening is, in fact, no a random operation, but deter mined by the extent of the tract and directions of the feathers. At the time of hatching, however, the duckling is clad in down whic exhibits no pterylosis, being evenly distributed over the body as in the supposedly primitive arrangement of adult Ratites and the *Sphenisci*. The contour feathers make their first appearance as sprouts at three weeks and are not fully developed until much later. As early as the age of five *hours* the ducklings (incubator-hatched) may commence to preen. From the start they go through the specific adult motions, although these are quite meaningless during the period of weeks in which the uniformly distributed coat of down is their sole covering. In this case it is not a morphological structure that precedes the appearance of a controlling habit, but a habit that precedes the development of a morphological character, to the topography of which the practice appears to be directly adapted.

Mr. Hochbaum has also pointed out that a young duckling, incubator-hatched and isolated from grown birds, when stretching, does it in the familiar adult fashion as if the primaries were already present; yet it then possesses merely rudiments of wings and no wing-feathers against which to press its outstretched leg. The leg nevertheless goes through the motions appropriate to the adult state.

I should point out that while these facts emanate from Mr. Hochbaum, he is not to be held responsible for the suggested interpretation.

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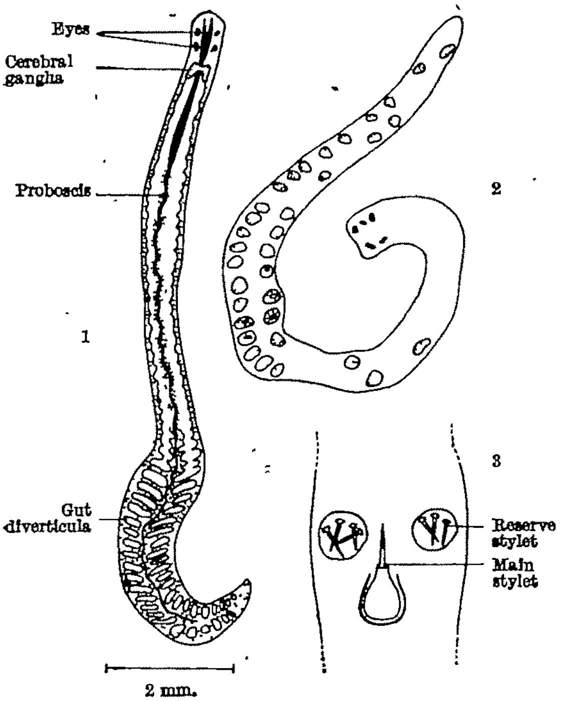
A British Freshwater Nemertine

On July 12, 1944, while collecting planarians in the Cam at Cambridge, we found a small orange-coloured worm in the leaf axils of *Glyceria aquatica* stems. Afterwards many more were found. The general structure, including the proboscis, showed clearly that it was a nemertine. The only freshwater nemertine previously recorded from Great Britain was a single specimen found by Benham[1] in the River Cherwell, of which, however, there is no full description. There is also a single record of a freshwater nemertine from Ireland in Co. Dublin[2]. The present record is therefore of interest.



Prostoma Græcense: 1. Dorsal view. 2. Diagram showing distribution of ova. 3. Main and reserve stylets.

The worms were not uncommon in association with *Glyceria*, it being an easy matter to collect some six specimens in an hour. It was distributed widely in the Cam and its tributaries between Cambridge and Harston, although weirs occur along this stretch of the river. We did not have an opportunity to search beyond these limits, but we were informed that a single specimen had been found in the Great Ouse near Over (September 13, 1944). The worms were still abundant in the Cam throughout the autumn, but had disappeared by November 24, by which time the *Glyceria* with its associated turbellarian fauna was dying down. In July nearly all the individuals contained eggs, though none was found in specimens collected during November. Small isolated specimens have again been found this year, the first on March 21. It is of interest that one of these specimens contained actively moving sperm in the testes.

The worms ranged in size from 5 mm. to 20 mm. in length, and from 0·5 mm. to 1 mm. in width. They were usually orange-red in colour, but yellow and almost colourless individuals were found. In addition the surface was often flecked with brown pigment. The accompanying drawings indicate the general structure of the worms. The mouth and rhynchodæum have a common opening. There are four to eight eyes, the number and degree of development of which is very variable. The few specimens so far sectioned have ten proboscis nerves. There appear to be commonly two stylet sacs, each containing three to five reserve stylets, on either side of the main stylet. The length of the main stylet including the haft is approximately 95 μ.

Allowing for the variability in colour and eye number, the worms agree with the description of *Prostoma* (=Tetrastemma=*Stichostemma*) *græcense* (Bohmig). This species is characterized by the possession of a common opening for the mouth and rhynchodæum (differentiating it from *P. clepsinoides*), and by the possession of ten proboscis nerves (differentiating it from *P. eilhardi*). Bohmig records[3] *P. græcense* from the Botanic Gardens at Graz, and from mud in a stream at Prague. The nemertine recorded by Southern in Ireland was referred by him to the species *P. clepsinoides*. As Hallez points out[4], the two species are closely related. Unfortunately, Benham's single specimen from Oxford was accidentally destroyed before it could be fully identified.

We should be glad to receive any information about the distribution of this freshwater nemertine in other parts of the British Isles.

We wish to thank Dr. C. F. A. Pantin for his interest and help in making these observations.

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The Popliteal Facet in Men who Habitually Squat

Some interest has centred around the variations in the lower end of the femur occasioned by the squatting posture[1-4], and the present communication is to record yet another variation in the lower end of femora from Punjabis of lower classes, who adopt the squatting posture not only during work but also during rest. In a series of two hundred femora examined, a curved facet, covered with cartilage, was detected in all of them in the posterior part of the lateral aspect of the lateral condyle. It was well marked in some, less so in others, but was present in all. This facet may be looked upon as an extension of the femoral condylar articular cartilage on the lateral aspect posteriorly, just as the quadriceps facet[1] is an extension of cartilage anteriorly.

The popliteal muscle arising from the anterior end of the popliteal groove on the lateral side of the lateral femoral condyle, and being inserted on the upper end of the posterior surface of the tibia, lies in the popliteal groove during flexion of the knee joint but moves in an arc on the lateral side on the lateral femoral condyle during the movement of extension, until the tendon lies obliquely from before backwards, bevelling the anterior part of its lower border. The friction between the tendon and the side of the condyle is obviated by the synovial membrane acting as a bursa.

As the movements of the knee joint are more frequent in squatting than non-squatting races[1], the popliteal tendon rubs against the lateral condyle much more frequently in the former than in the latter. The popliteal facet seems to owe its existence to this fact.

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Effect of High Vitamin A in the Diet of Domestic and Non-Domestic Animals

THE purpose of this study was to learn the specific effect of diets containing medium and large amounts of vitamin A upon the digestive equipment of domestic animals, and of wild animals kept in captivity. Vitamin A has been found to be essential for the development and growth of young animals; quite characteristically it has been found to enhance metabolism and promote assimilation, and thus it is obvious that this very quality results in the promotion of growth and development, for the latter is based upon normal metabolism and the elimination of residual matter in the living body.

The first study was made in connexion with the diet of a thoroughbred German Shepherd bitch which had developed a chronic diarrhœa which had persisted over a long period of time. This dog was fed regularly and was not exposed to infection or to contaminated food. She had no intestinal parasites; her food consisted of the cooked lights (lung), liver and heart from sheep, and the broth therefrom. Evaporated milk diluted with water and dog biscuit were given for the second daily meal. The dog was apparently perfectly well, the coat was heavy and lustrous, her vitality unimpaired. However, the persistent diarrhœa left no doubt that her diet contained something which had the effect of a laxative.

In order to trace the offending factor in the diet, the milk was eliminated first, but put back when found to be inoffensive. The dog biscuit was tested in the same manner, and finally the heart, lung and liver. By the process of elimination it was determined that liver was the substance which was responsible for the diarrhœa. Only two days after elimination of the liver from the diet, the dog had perfectly normal bowel discharges and has remained perfectly well ever since.

Liver is one of the organs of the animal body which stores up vitamins in large amounts. Vitamin A, apparently, contained in the liver, was responsible for the accelerated metabolism resulting, in turn, in diarrhœa in the dog. Other organs, like kidney and spleen, also rich in vitamins, but probably containing less vitamin A, had a similar effect, but not quite so pronounced. The liver, kidney and spleen were more laxative when fed raw than when given cooked, some of the effect of the vitamin being destroyed when exposed to heat.

Later dietary studies were extended to wild rabbits kept in captivity. Many experiments to raise these animals in captivity have failed because of the mistake made of feeding them standard domestic rabbit rations. Wild rabbits, due to their extremely rapid growth during the first few weeks of their life, require unusual amounts of vitamin A. The milk of rabbit does is known to be richer in butter fat (containing vitamin A) than the milk of most other animals. As the rabbits are weaned, they select for their first solid food such weeds which are richest in vitamins A and C, like dandelion and clover, while delicacies such as fresh peas, lettuce and cabbage were steadily rejected by the experimental animals. Another interesting observation was that carrot tops, which were accepted by wild young rabbits when no dandelion was available, resulted, given in large quantities, in diarrhœa and sickness. Carrot tops are known to contain an abundance of vitamin A.

To confirm these findings regarding the laxative properties of vitamin A, concentrates of this vitamin were administered to the dog together with an otherwise normal diet. The effect produced by vitamin A concentrates was the same as that reported for natural foods containing this factor in large quantities. Afterwards, other foods known for their high vitamin A content were tested in relation to their effect upon the digestive tract of animals. Among these foods were: carrots (root), tomatoes, suet, honey and molasses. All these substances confirmed the previous findings that high vitamin A content accelerates metabolism to the point where it causes diarrhœa in cases where large amounts are contained in the food ingested.

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Spontaneous Regression of Histologically Malignant Tumours Induced in Rabbits by 9 : 10-Dimethyl-1 : 2-Benzanthracene

BERENBLUM has reported[1] the induction of squamous carcinoma in rabbits with 9 : 10-dimethyl-1 : 2-benzanthracene.

The ears of eleven rabbits were painted with a solution in acetone of 0·3 per cent 9 : 10-dimethyl-1 : 2-benzanthracene (which was kindly supplied by Prof. J. W. Cook), for sixteen weeks, without immediate effect. The strength of the solution was then increased to 2 per cent, after which papillomas in five rabbits appeared within three to six weeks. Clinical evidence of infiltrating growth was noted in three rabbits after further periods of four, seven and sixteen weeks respectively. The tumours measured 1·5–4 cm. in diameter, and extended from their origin on the inner side of the ear to the subcutaneous tissue of the outer side, bulging out the skin. Biopsy of one tumour was done, and reported by Dr. P. R. Peacock as having the appearance of a squamous carcinoma penetrating lacunæ in the cartilage.

Two rabbits were used for therapeutic experiments, but the attempt was abandoned after one injection in one rabbit, and after two injections in the other, because the solution used caused phlebitis. No therapeutic effect was observed within three weeks n the first rabbit, and within four weeks in the second rabbit. After this period, painting was discontinued, and both tumours, as well as the untreated control tumour, regressed completely within five weeks.

The observation suggests that in tumours induced by 9 : 10-dimethyl-1 : 2-benzanthracene in rabbits, as in tar carcinoids, histological malignancy is not necessarily irreversible. These tumours, therefore, may not be classified as truly malignant, in spite of their histological appearances, and are not suited for therapeutic experiments.

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[1] Berenblum, I., *Cancer Res.*, 5, 265 (1945).

Phase Transitions in Condensed Monolayers of Normal Chain Carboxylic Acids

INVESTIGATIONS using a thermostated double-acting recording surface balance of the Wilhelmy-Dervichian type[1,2] reveal an interesting series of phase changes in condensed monolayers of normal chain fatty acids of high molecular weight. As an example, we may take the surface pressure – area curves for *n*-docosanoic (behenic) acid[3] spread on acid (0·01 *N* hydrochloric acid) substrate shown in Fig. 1. At the lowest temperature the solid film gives a smooth pressure – area curve and the area can be reduced down to about 18·6 sq. A. per molecule before a gradual collapse sets in. At this area the chains are evidently vertical and as closely packed as in the normal three-dimensional hydrocarbon crystal, in which the cross-section of the chains[4] is about 18·4 sq. A. This close-packed solid phase may be denoted by *CS*. When the temperature is raised, another phase, L_2, appears[5], the stability range of which increases with temperature. At 8·2° a new phase, which we may call L'_2, appears and is quite marked in the curve for 10° in Fig. 1. At 13·8° the high-pressure phase *S* appears and the curve for 14·8° shows a transition $S \rightleftharpoons CS$ which is rapidly displaced towards higher pressures with raising temperature. Above 18°, *CS* has disappeared and *S* shows a sharp collapse at about 55 dynes pressure. The smallest area at which the phase *S* is stable is about 19·3 sq. A. It seems likely, therefore, that the molecules are vertical and perform strong torsional oscillations[6] or complete rotations, as the area per chain corresponds to that found in hydrocarbon crystals near the melting point[4]. (A few degrees below the melting point some hydrocarbons show a gradual, others an abrupt, change from a state of lower symmetry into one of hexagonal symmetry, in which the vertical chains are rotating about the long axis.)

As the temperature is raised, the transition $L_2 \rightleftharpoons L'_2$ becomes less marked. The transition $L'_2 \rightleftharpoons S$ is of the second order from its first appearance at 13·8°–22°, but over the temperature range 22°–29° the transition from the L'_2 phase is of the first order. Harkins and Copeland[7] have recently studied a similar phenomenon in monolayers of *n*-octadecanol-1. They found a triple point at 7·5° with the appearance of a new phase called *LS*, characterized by a very low viscosity. Over a certain temperature range the transition $L_2 \rightleftharpoons LS$ was of the first order. The existence of an *LS* phase in monolayers of *n*-docosanoic acid is suggested by a decrease in film viscosity (or rigidity; when the chains are very long, both L_2 and L'_2 are solid) at the transition from the L'_2 phase at temperatures above 22°, and by the break in the high-pressure portion of the curves above this temperature (more marked at higher temperatures, see Fig. 1) which is probably due to an $LS \rightleftharpoons S$ transition. It is difficult to determine the order of this transition, owing to instability of the film at the high pressures involved, but it appears to be a second order one. The same also applies to the $S \rightleftharpoons CS$ transition.

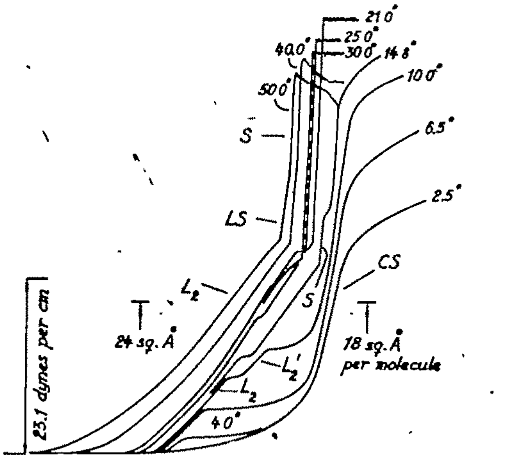

Fig. 1.

Experiments with the Langmuir-Adam balance show that on compression the pressure remains constant over a certain area range during the transitions $L_2 \rightleftharpoons CS$ and $L'_2 \rightleftharpoons CS$, and these are therefore of the first order. There is a certain amount of hysteresis, however, and the curves in Fig. 1, which have been redrawn from automatically recorded curves, are not quite horizontal during the transitions. The transition $L_2 \rightleftharpoons L'_2$ is also of the first order below about 23°, but probably becomes second order above this temperature. The changes in the pressure-area curves are very small, however, and it is difficult to determine the order exactly. Diffuse first-order transitions and

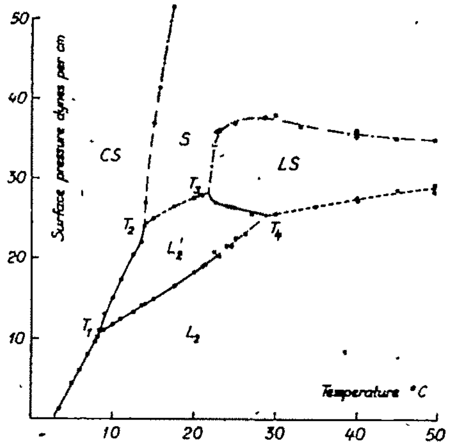

Fig. 2.

third-order transitions in monolayers have been considered by some authors[8], but according to Lifshitz[9] only first- and second-order transitions are thermodynamically possible.

The surface pressure – temperature diagram for *n*-docosanoic acid is shown in Fig. 2. Unbroken heavy lines represent lines of first-order transitions and dotted heavy lines second-order transitions. A dash-dotted thin line indicates that the order of the transition is uncertain. The phases L_1 ('liquid expanded') and G (gaseous) are not included. There are four triple points: $T_1 \sim 8{\cdot}2°$, $T_2 \sim 13{\cdot}8°$, $T_3 \sim 22°$, $T_4 \sim 29°$.

The temperatures at which the various transitions occur are raised by about 5° for each added CH_2 group. If a mixture of acids has the same mean molecular weight as a pure acid, the set of curves given by the mixture will be very closely similar to that given by the pure acid, provided that the chains in the mixture do not differ by more than two carbon atoms in length.

The close-packed *CS* phase has also been found for methyl and ethyl esters of long normal acids and for alcohols and acetates, and will probably be found in other cases, provided that the chains are long enough or the temperature low enough, and the cross-section of the head group is less than that of the chain. *n*-Docosyl acetate shows all the transitions described above for *n*-docosanoic acid. The L'_2 phase has so far been found only for acids and acetates.

A detailed account of the investigation will be published elsewhere.

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May 5.

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[1] Andersson, K. J. I., Stållberg-Stenhagen, S., and Stenhagen, E., article in "The Svedberg 1884–30/8 1944" (Uppsala, 1944), p. 11.

[2] The instrument used in the work described is a modification of that described in ref. 1. The monolayer is compressed symmetrically with respect to the Wilhelmy glass slide by two barriers moving in opposition to each other. This arrangement is necessary when very solid monolayers are investigated.

[3] A very pure specimen of *n*-docosanoic acid (impurityp resent amounting only to a few parts per 10,000) obtained from Prof. F. Francis, Bristol, was used. Cf. Francis, F., and Piper, S. H., *J. Amer. Chem. Soc.*, **61**, 577 (1939).

[4] Müller, A., *Proc. Roy. Soc.*, A, **138**, 514 (1932).

[5] The nomenclature used by Harkins and Copeland, ref. 7, and Lifshitz, ref. 9, is employed.

[6] Alexander, A. E., *Trans. Far. Soc.*, **37**, 426 (1941), *Proc. Roy. Soc.*, A, **179**, 470, 486 (1942).

[7] Harkins, W. D., and Copeland, L. E., *J. Chem. Physics*, **10**, 272 (1942); Copeland, L. E., Harkins, W. D., and Boyd, G. E., *J. Chem. Physics*, **10**, 357 (1942). The existence of a first-order transition over a certain temperature range in monolayers of *n*-eicosanol-1 might be inferred from earlier work by Schulman, J. H., and Hughes, A. H., *Proc. Roy. Soc.*, A, **138**, 430 (1932).

[8] Compare Harkins, W. D., Young, T. F., and Boyd, E., *J. Chem. Physics*, **8**, 954 (1940).

[9] Lifshitz, E., *Acta Physicochim. U.R.S.S.*, **19**, 248 (1944).

Infra-Red Spectra of Coals

IN a recent paper on the infra-red absorption spectra of coals[1], we mentioned an unsuccessful attempt to obtain such spectra by examining the infra-red transmission of finely ground coals dispersed in 'Nujol' (liquid paraffin).

A more detailed investigation of the dispersion technique has now given satisfactory spectra. We have found that it is essential to get down to a particle size of the order of 1 μ and to use an effective path-length of at least 50 μ. Although under these conditions the energy transmitted by a 'coal-Nujol' film is so low that large slit widths are necessary to measure the transmission, spectra with quite well defined bands are obtained.

Using this technique, the spectra of a series of coals supplied by the British Coal Utilisation Research Association have been recorded and characteristic differences in the spectra of coals of differing rank and origin have been detected.

A detailed account of this work, which forms part of a programme of fundamental research on the spectra of coals carried out for the British Coa Utilisation Research Association, will be published elsewhere in the near future.

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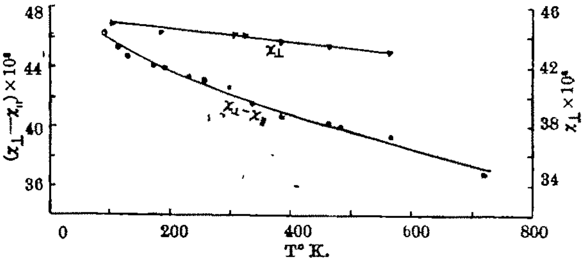
[1] Cannon and Sutherland, *Trans. Far. Soc.*, **41**, 280 (1945).

Effect of Temperature on Magnetic Susceptibility of Molybdenite Crystals

THE structure of the molybdenite crystal has been determined by Pauling and Dickinson[1] and Hassel[2]. They found that the molybdenum and sulphur atoms in it are arranged in separate layers perpendicular to the *c*-axis. Each layer of molybdenum atoms has two layers of sulphur atoms on opposite sides of it. The whole structure is then built up by the repetition of composite layers each of which is formed by a molybdenum layer sandwiched between two sulphur layers. The excellent cleavage in a plane parallel to the layers themselves may be regarded as a natural consequence of the large distance between these successive composite layers. In layer structures of this type, it seems that the major portion of the primary valencies is exercised within the layers themselves, and only secondary forces hold the layers together to form the crystal lattice.



In view of the above considerations, magnetic studies on single crystals of molybdenite were undertaken and interesting results[3] have been obtained. The difference between the two principal susceptibilities $\chi_\perp - \chi_\parallel$ has been found to be $42{\cdot}8 \times 10^{-6}$ per gm. mol; and $\chi_\parallel$, the absolute value of the susceptibility along the *c*-axis, being $-87{\cdot}1 \times 10^{-6}$ per gm. mol. Thus the anisotropy is found to have the high value of about 72 per cent. Recently these measurements have been extended to various temperatures both high and low. The results are shown diagrammatically in the accompanying graph. It has been found that there is a large temperature variation of $\chi_\perp - \chi_\parallel$, the difference between the principal susceptibilities. It varies from $46{\cdot}4 \times 10^{-6}$ at about 90° K. to $36{\cdot}8 \times 10^{-6}$ at about 700° K. On the other hand, $\chi_\perp$, the susceptibility at right angles to the symmetry axis, has been found to vary quite slowly with temperature, namely from $-45{\cdot}01 \times 10^{-6}$ at 90° K., to -43×10^{-6} at 566° K. Details of these investigations will shortly be published elsewhere.

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[1] Pauling, L., and Dickinson, R. G., *J. Amer. Chem. Soc.*, 45, 1466 (1923).

[2] Hassel, O., *Z. Krist.*, A, 61, 92 (1924).

[3] Dutta, Ajit Kumar, *Ind. J. Phys.*, 18, 249 (1944).

Viscosity of Ordinary Liquids at High Rates of Shear

THE viscosity, η, of a fluid can be represented by[1]

$$\eta = \left(\frac{N}{V}\right)^{2/3} \cdot \frac{c.(2.\pi.m.k.T)^{1/2}\, R.T}{E_T} \cdot e^{\frac{E_{\text{visc.}}}{R.T}}, \quad . \quad (1)$$

where N is Avogadro's number ; c is a packing factor ; m is the mass of a molecule ; k is Boltzmann's constant ; $E_{\text{visc.}}$ is the energy of activation of viscous flow ; V is the molecular volume ; E_T is the sum of the potential and the kinetic energy of the molecules. We have found that E_T can be expressed as the sum of the latent heat of vaporization ($\triangle E_{\text{vap.}}$) and a multiple of $R.T$ ($d.R.T$). It has been shown[2] that $E_{\text{visc.}}$ equals the work of cohesion for non-associated liquids, and from this fact it was deduced that $E_{\text{visc.}}$ equals the bond energy between two interacting molecules. Further, it has since been deduced that $\triangle E_{\text{vap.}} = b.E_{\text{visc.}}$, where b is a factor depending on the mean co-ordination. Thus both $\triangle E_{\text{vap.}}$ and $E_{\text{visc.}}$ depend on the number of bonds per mole, formed by the interaction of the molecules.

The number of closed bonds, N', will, apart from the mean co-ordination, be a function of the co-ordination frequency, z, that is, $N' = f(z)$, and to a first approximation $N' \propto 1/z$. In a stationary liquid the molecules are in thermal agitation and z will have a certain value, depending on the temperature. In a liquid under flow, 'agitation of flow' will be superimposed on the thermal agitation. If z_1 is the co-ordination frequency in the stationary liquid and z_2 that frequency in the moving liquid, then f, the ratio of the number of closed bonds in the moving liquid, n, to that in the stationary liquid, N', will be given by

$$f = \frac{n}{N'} = \frac{z_1}{z_2} \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

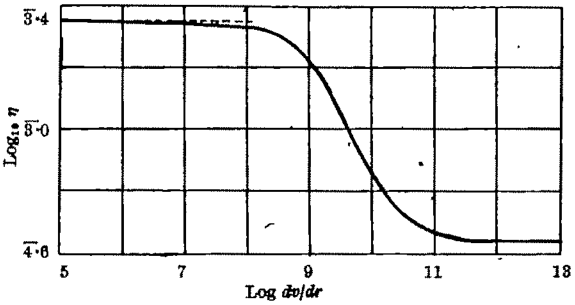
For z_2 one may write $z_1 + z_3$, where z_3 is the increase in co-ordination frequency due to viscous flow. If the molecular layers are moving with relative velocity v_r and the intermolecular distance is λ, then $z_3 = v_r/\lambda$. It is to be noted that z_3 according to this definition is also equal to the rate of shear in the liquid. So long as $z_1 \gg z_3$, the factor f will be practically equal to 1 and $\triangle E_{\text{vap.}}$, $E_{\text{visc.}}$ and η will be independent of the rate of shear. When z_3 approaches values comparable with z_1, f will no longer be unity, and both $\triangle E_{\text{vap.}}$ and $E_{\text{visc.}}$ will be reduced to a fraction f of their value. Then equation (1) becomes

$$\eta = \left(\frac{N}{V}\right)^{2/3} \cdot \frac{c.(2.\pi.m.k.T)^{1/2}\, R.T}{f.E_{\text{vap.}} + d.R.T} \cdot e^{\frac{f\,E_{\text{visc.}}}{R.T}} \quad . \quad (3)$$

To evaluate f: z_3, the rate of shear, is given by the experimental conditions ; z_1 can be obtained approximately from the coefficient of self-diffusion, D ; D will be approximately of the same order of magnitude as the coefficient of diffusion observed in solutions. Using the Stokes-Einstein relation, one obtains

$$z_1 = \left(\frac{N}{V}\right) \frac{k.T}{6.\pi.\eta} \quad . \quad . \quad . \quad . \quad . \quad (4)$$

Using equations (3) and (4), the viscosity of n-pentane at 30° C. and at high rates of shear was calculated (see graph). One can see that the viscosity of n-pentane will reveal its dependence on the rate of shear at a value of approximately 5×10^8 sec.$^{-1}$ of the latter.



From equation (4) one can deduce that

$$z_1 \times \eta_0 \times V = \text{constant},$$

at constant temperature and very nearly

$$z_1 \times \eta_0 \times M \sim \text{constant}, \quad . \quad . \quad . \quad (5)$$

where η_0 signifies the 'Newtonian' viscosity and M the molecular weight. The value of z_3 at which the viscosity will become markedly dependent on the rate of shear will be about 10^3 times smaller than z_1. Let $(dv/dr)_{\text{lim.}}$ be the value of the rate of shear at which the effect can be observed, then one may write

$$(dv/dr)_{\text{lim.}}\, x\eta_0 = \frac{\text{constant}}{M} = \text{limiting shear stress.}$$

For n-pentane at 30° C. the limiting shear stress is found to be about 10,000 dynes/cm.^{2}.

From the theoretical considerations brought forward, one may conclude that at high rates of shear the viscosity of 'Newtonian' liquids may be expected to become a function of the rate of shear. The value of the rate of shear at which the effect becomes perceptible depends on the relative magnitude of the thermal agitation of the molecules and the 'agitation of flow'.

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[1] Guareschi, P., *Atti Acad. Sci. Torino*, Disp. 2a, 118 (1939).

[2] Grunberg, L., and Nissan, A. H., *Nature*, 154, 146 (1944).

Visible Glow Discharge at Very Low Potentials

It is a well-known phenomenon in gas-filled photo-electric cells that, if the cathode is exposed to illumination, a faint glow is visible within the cell at anode potentials well below the striking potential, that is, below the potential at which the self-maintained discharge starts. Owing to the fact that, as a rule, this glow is of low brightness as compared with the light source which is used to cause the photo-electric emission, it is difficult to establish the anode potential at which the glow begins.

This glow can, however, be observed in complete darkness if a photo-cell of the silver–oxygen–cæsium type, which is sensitive to infra-red radiation, is exposed to a light source through an infra-red filter. By experiments with such a photo-cell containing argon, it was found that a glow is visible at anode potentials as low as 18 volts (the current in this case was 1 μamp.), that is, at a potential only slightly above the ionization potential of argon. This means that a glow commences as soon as ionization by collision takes place.

When the anode potential is gradually reduced from higher values to 20 volts the discharge, which at first fills the whole cell, recedes to the immediate neighbourhood of the anode. This effect is to be expected, because at low anode potentials the photo-electrons will not have sufficient energy to cause ionization by collision until they have almost reached the anode.

I am indebted to Dr. G. B. Harrison, of Messrs. Ilford, Ltd., for directing my attention to the fact that in gas-filled photo-cells a glow is visible at low anode potentials if the cells are observed in darkness.

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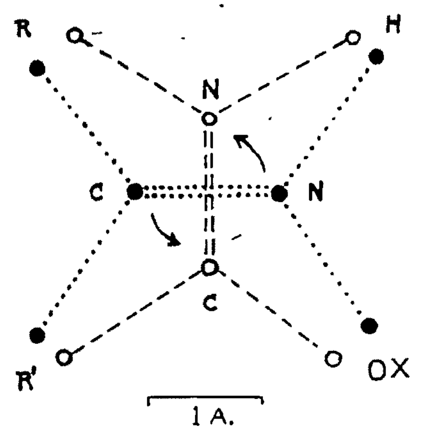
Mechanism of the Beckmann Rearrangement

I have recently received my copy of *Chemical Reviews* for December 1944 and find in it yet one more survey of the Beckmann rearrangement and confession of failure to 'explain the mechanism' in the classical sense.

The diagram shows scale drawings of the oxime before rearrangement (full circles and dotted lines) and the *RN* : *CR*'OX resulting from the change (open circles and dashed lines) superimposed so as to have the same centre of gravity, and minimum rotational movement of the heaviest parts. Both compounds are represented with a proton attached to the nitrogen atom: this is probably the case under most reaction conditions, but is not a necessary feature of the views advanced here. It will be seen that it is only the carbon and nitrogen atoms which move an appreciable distance. The only other movements required are of the atoms directly attached to these, and these movements can all be taken up in the first instance by a 10° bending of the links. The contribution of this to the activation energy can be estimated from the spectroscopic data on bending frequencies —which are mostly of the order of 600 cm.$^{-1}$—and amounts to between 20 and 50 kcal./mole depending on the masses of the attached atoms.

The 'mechanism' of a reaction in the classical sense means the order in which valency bonds are broken and made. We are familiar with a partial abandonment of this in the recognition that in a reaction such as halogen exchange between halide ions and alkyl halides there is a simultaneous 'make' of one link and 'break' of another, and it is further recognized that whenever the activation energy of a reaction is less than the dissociation energy of the bonds which are broken, some such simultaneous make-and-break occurs. In more detail, as the nuclear configuration passes from that of the reactants to that of the products, it passes through an intermediate or transition form which may be regarded as a distortion of either. Therefore distorted forms of the initial and final bond systems are both possible approximately canonical forms for the electronic configuration in the transition state, and the actual configuration will be a resonance hybrid of these. This results in a diminished restoring force or 'weakness' towards any thermal vibration which tends to carry the reactant over into the product.



● ......, atoms and bonds before reaction.
○ - - - -, „ „ „ after „

The description of the previous paragraph applies word for word to the Beckmann change. However, (1) it is probably necessary for the slow thermal movements of the attached groups to be in a favourable phase for reaction to occur (otherwise larger bending of the links is involved) and (2) when reaction does occur the number of bonds made and broken is relatively large, so that the reaction appears complicated. But it is essentially a one-stage mechanism defying further analysis, and, moreover, the word 'migration' is an extremely misleading term. The mechanism as outlined explains all the qualitative features of the Beckmann and allied reactions—the intramolecularity, the *trans* migration, and so on, and also semi-quantitatively the effects of substituents in the groups. It may be added that a similar explanation can be drawn up for the pinnacol-pinacoline group of rearrangements, including as a natural consequence the Walden inversion which occurs on the carbon atom which remains capable of optical activity.

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SOME FRENCH AND GERMAN GEOGRAPHICAL AND GEOLOGICAL INSTITUTIONS

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THE following notes, which may be useful to geologists and biologists, were compiled during a series of visits in the past few months to several museums and universities in Europe, while I was attached to the U.S. Army. I have been to all of those mentioned below, with the exceptions of Monaco and Berlin. All German universities seen were operating at about half pre-war enrolment during the winter semester 1944–45.

France

Monaco. The director of the Oceanographic Museum, Dr. Richard, died in February. His successor is Commandant Rouch. The Museum is said to have been slightly damaged by the explosion of a 'porpoising' torpedo last summer.

Paris. Prof. E. de Margerie, now in his early eighties, is well, and is actively engaged in the publication of his memoirs ("Critique et Géologie"), a four-volume quarto historical survey of the development of some aspects of geological and geographical science since 1884. The first volume has appeared recently (Armand Colin, 500 fr.). The others are in advanced stages of preparation and publication.

No important changes have occurred at the Sorbonne or the École des Mines. At the Jardin des Plantes the director of the Laboratoire de Paléontologie is now Dr. Arambourg.

Strasbourg. Most of the University staff, including the Service Géologique d'Alsace, headed by Dr. G. Dubois, were evacuated to Clermont-Ferrand during 1939–40. Geological and geographical books, maps and specimens left in Strasbourg were used by the Germans, and the choice things taken into Germany proper. Prof. O. Haas, whose personal library and collections from central Africa are intact, alone remained behind throughout the occupation. The geological building is undamaged by bombing.

Germany

Berlin. At the Bavarian Geological Survey, I met two geologists, one Dutch, the other German, who had been in Berlin as late as February 1945. They stated that: the Preussische Geologische Landesanstalt and the Museum für Naturkunde are quite destroyed; the library and archives of the former were safely evacuated, but only a few types were saved from the Museum; the splendid skeleton of *Brachiosaurus* is lost; at that time both Prof. O. H. Schindewolf and Prof. H. Stille were well and active. This information seems authentic.

Bonn. The Geographisches Institut is a total loss, but its contents had been mostly evacuated across the Rhine. The Geologisch-Paläontologisches Institut is damaged somewhat by blast, but all important collections, such as that of Goldfuss, were safely evacuated. Prof. H. Cloos is still director.

Cologne. The Geographisches Institut is badly damaged, and the contents were not evacuated.

Darmstadt. The Geologisches Institut and Hessische Geologische Landesanstalt were totally wrecked.

Erlangen. Undamaged. Nothing evacuated from the Geologisches Institut. Most of the staff, with the exception of Prof. L. Krumbeck and another, in the German army.

Frankfurt A/M. The Geologisches Institut of the Goethe University is wholly demolished, and the Senckenberg Museum is reduced almost to a hollow shell. The material was mostly evacuated, and, in the case of the Senckenberg, all research collections and stocks of publications and library are safe. Dr. R. Richter, the director, was in Bucharest when that city capitulated, and is now interned by the Russians. Two years ago he published an extensive paper on the rules of zoological nomenclature and nomenclatural problems, "Einführung in die Zoologische Nomenklatur durch Erlauterung der Internationalen Regeln", *Senckenberg. Naturf. Gesellsch.*, 1943 [a copy is now in the British Museum (Natural History) Zool. Dept. Library]. The acting director is Dr. H. T. Reuling. The only actual losses at the Senckenberg Museum, besides the building, were a number of large plaster casts (including the large one of *Diplodocus carnegiei*) and a large ornithological collection. The Senckenberg authorities have carefully saved their publications ordinarily destined for the countries of the Allied Nations, and are hoping to be able to distribute them.

Heidelberg. Undamaged, but most of the collections of the Geologisch-Palaontologisches Institut were evacuated, including large quantities of material from the Mauer deposits. For the last few years there have been three regular staff members, of whom only one, Dr. Florian Heller, was there at the time of my visits. Prof. J. Wilser is head; additional teaching aid was given by Dr. Salomon and Dr. E. Jaworski.

Innsbruck. The University is undamaged. The Geographisches Institut, headed by Prof. H. Kinzl, is in working condition, although most of the non-current library was evacuated. The collections and library were largely evacuated from the Geologisch-Palaontologisches Institut in the Alte Universitat, and are now being moved in again. The Mineralogisches und Petrographisches Institut, still presided over by Prof. B. Sander, is carrying on.

Jena. The Mineralogische Anstalt is totally demolished and apparently was not wholly evacuated before the main bombing three weeks before the fall of the city. The Geographische Anstalt, mostly evacuated, was somewhat damaged by blast. The building temporarily houses the Geologisches Institut of the University of Breslau. No information about staff.

Munich. The main University building is very badly damaged. The Geographisches Institut is relatively undamaged, but rooms have been taken over by the Universitäts-Kanzlei. The Technische Hochschule is not badly damaged; Dr. Wilhelm Credner has been very active during the War, like most German geographers.

The Bayerische Akademie building is a total wreck, and of the vast geological, palæontological and mineralogical collections, only about 250 cases, a very small part, were saved. All the fossil vertebrate collections were destroyed, as well as the Zittel Collection. The building of the Geographische Gesellschaft was wholly destroyed and the entire library lost.

Würzburg. The Geographisches Institut is completely demolished, but most of the equipment had apparently been moved to the country. The Mineralogisch-Geologisches Institut was slightly damaged by blast, nothing evacuated; and, being one of the few habitable buildings in the city, is now used for billeting. No staff members seen.

USES AND LIMITATIONS OF PENICILLIN

RECENTLY brief summaries were given in this journal of some of the work which has been done on the absorption, excretion and local application of penicillin (*Nature*, **155**, 341, March 17, 1945) and on its remarkably successful use for the treatment of syphilis and other spirochætal infections and also of gonorrhœa (*Nature*, **155**, 459, April 14, 1945). Since those articles were written, many reports on its use have appeared, and some of them are summarized below.

Much recent work has been concerned with the limitations of penicillin. Apart from the failure of penicillin to act upon the organisms which cause tuberculosis, cholera, plague, malaria, smallpox and other serious diseases of man and animals, one of its limitations is the inadequacy of the supply of it and the difficulties of the large-scale manufacture of it. There are, however, many indications in the medical and scientific Press that enough penicillin will, before long, be available for dealing with all the illnesses which can be successfully treated with it. The *Lancet* (408, March 31, 1945) notes that the largest plant in the world for the production of penicillin is now being erected at Speke, near Liverpool, but the Ministry of Health does not expect that penicillin will be available just yet through ordinary commercial channels. E. W. Flosdorf (*Brit. Med. J.*, 216, Feb. 17, 1945) gives a technical account of the process of drying penicillin by sublimation as used in the United States and Canada; he discusses, with references to the literature, the problems encountered, and compares them with those presented by the drying of blood plasma. H. Welch *et al.* (*J. Inf. Dis.*, **76**, 55; 1945) have studied the relative toxicity of seven different salts of penicillin and have placed them in the following order of increasing toxicity: sodium, lithium, ammonium, strontium, calcium, magnesium, potassium. All seven salts were equally effective in the treatment of pneumococcal infections of mice.

One limitation of penicillin is its instability (see *Brit. Med. J.*, 272, Feb. 24, 1945), especially when it is made up in the form of pastilles, creams and ointments. It seems likely (see below) that this difficulty may soon be overcome. Of some importance also is the report by S. T. Cowan (*Lancet*, 178, Feb. 10, 1945) that some kinds of rubber inactivate a considerable portion of the penicillin exposed to them and that there is ample time, during the intramuscular administration of penicillin through some kinds of rubber tubing, for the destruction of 25–50 per cent of the penicillin. Cowan describes a simple method of testing the action of rubber tubing on penicillin. Possibly this difficulty will be overcome by the use of tubing made of plastic materials which is now becoming available for surgical work.

Another limitation of penicillin, less easy to overcome and requiring the use of relatively large quantities of the drug, is the fact that, although it rapidly enters the blood and quickly establishes an antibacterial concentration there, it is very rapidly excreted, so that it must be administered continuously (see *Nature*, **155**, 341, March 17, 1945). For this reason it has been found that the best method of giving penicillin is to inject it into the muscles, either by continuous drip or at intervals of three hours or so. This method necessarily gives the subject much pain and discomfort, and disturbs the rest necessary for recovery. Further, penicillin given systemically in this way may fail to reach organisms walled off by inflammatory reactions or lying in the recesses of septic wounds and in bony tissues. Efforts have therefore been made to devise better methods of getting penicillin into that close contact with infecting organisms which it requires for its action. Such methods would at the same time avoid the use of the large quantities of the drug required by systemic administration.

One method of avoiding the pain and disturbance of parenteral administration which has had some success is giving by the mouth. The difficulty here is that penicillin is destroyed by the acid of the gastric juice and by enzymes of the bacteria commonly present in the lower bowel (*Lancet*, 214, Feb. 17, 1945). C. H. Rammelkampf and C. S. Keefer (*J. Clin. Invest.*, **22**, 425; 1945) showed that penicillin *in vitro* is not destroyed by saliva, bile, succus entericus or pepsin, and that, if it is given by duodenal tube, more of it enters the blood than if it is given by the mouth. A. H. Free *et al.* (*Science*, **100**, 431; 1944) showed that, if large doses (100,000 units) are given by the mouth to normal people, 8–33 per cent of the penicillin can be recovered from the urine; but if an alkali (sodium bicarbonate) is given with the penicillin, the amount of penicillin recovered from the urine is reduced, not increased. Penicillin is, however, inactivated more quickly by alkali than by acid. C. J. H. Little and G. Lumb (*Lancet*, 203, Feb. 17, 1945) mixed penicillin with raw egg, milk, plasma and other substances in an endeavour to overcome the effects of the *p*H of the alimentary canal upon it and reported that, if volunteers were given a dose of alkali (sodium bicarbonate or magnesium trisilicate) followed by a quarter of a pint of milk, and ten minutes later penicillin dissolved in saline and mixed with raw egg, a satisfactory antibacterial concentration is obtained in the blood. Their treatment of cases of tonsillitis by this method appeared to be satisfactory and they are trying it with cases of pneumonia, gonorrhœa and surgical sepsis. The same result was obtained with patients suffering from both achlorhydria and hyperchlorhydria. N. G. Heatley (*Lancet*, 590, May 12, 1945) repeated the methods of Little and Lumb and found that his results agreed in general with those of Rammelkampf and Keefer, but he could not confirm the levels of blood concentration and urinary excretion obtained by Little and Lumb. He suggests that the differences may be due to the methods of assay used. He did find, however, that the administration of penicillin in raw egg after bicarbonate and milk produced considerably higher levels of blood concentration and urinary excretion than administration of it in water; he suggests that this method may be effective for the treatment of gonorrhœa, although a dose at least three times as great as that now given by injection for this disease may be necessary. Gyorgy *et al.* (*J. Amer. Med. Assoc.*, **127**, 639; 1945) obtained cures of gonorrhœa by giving doses of 15–20,000 units of penicillin every three hours for two or three days with sodium citrate. J. C. Krautz, jun., *et al.* (*Science*, **101**, 618; 1945) find that aluminium aminoacetate is suitable for the oral administration of penicillin.

It does not follow, as the *Lancet* (597, May 12, 1945) points out, that results obtained with gonorrhœa will apply to other diseases, because gonorrhœa responds more consistently and rapidly to peniillin than any other infection. However, R. L. J. ibby *et al.* (*Science*, **101**, 178; 1945) obtained n inhibitory level of penicillin in the blood for ix hours by giving penicillin in cotton-seed oil by he mouth. W. MacDermott *et al.* (*Science*, **101**, 228; 945), on the other hand, had no success with the ethod of Romansky and Rittman (see *Nature*, **155**, 41, March 17, 1945) of giving penicillin by the outh in peanut oil and beeswax in order to prolong ts action in the body.

Other methods of administration which seek to liminate the pain and disturbance of parenteral dministration of penicillin, and also to put the enicillin into closer contact with the organisms conerned, develop the principle of its local application. he necessity for the close contact of penicillin with he organisms concerned, which arises perhaps from ts apparent mode of action, has been often demontrated by the failures of penicillin given parenterally o affect organisms walled off in abscesses or proected by other tissue reactions, by dead tissue and y their position in the recesses of bone. R. Mowlem *Brit. Med. J.*, 517, April 15, 1945) discusses the use f penicillin in infections of the mandible, concluding hat it is not likely to control infections there when equestra and unfavourable surgical conditions are resent. It is no substitute for surgery, as contriutors to the penicillin issue of the *British Journal of urgery* (see *Nature*, **154**, 677, Nov. 25, 1944) have lso pointed out.

Very recently Lady Florey and N. G. Heatley *Lancet*, 748, June 16, 1945) reported an important levelopment of the local application of penicillin. They set out to discover whether penicillin injected nto abscess cavities (in which, as several other workers have also shown, it may rapidly produce a terile pus and promote healing) would not only act ocally but also would be absorbed into the blood and would establish an antibacterial concentration there. They injected it into the pleural cavity of most of their patients, but they injected it also into the kneejoint and intrathecal space of others, as well as into abscess cavities. They found that penicillin injected at the rate of 120,000 units in 24 hours into the pleural cavity, after aspirating off the pleural effusion there, produces an antibacterial concentration in the blood which lasts for 24 hours or more; injection of 120,000 units into two intact but infected knee-joints also produced an antibacterial concentration in the blood for at least 13 hours in one patient and for 24 hours in the other. The dose for children up to eight years is calculated on the basis of 1,000 units per lb. of body weight per 24 hours. An antibacterial concentration in the blood was also obtained by the injection of penicillin into an abscess cavity in a case of streptococcal septicæmia with multiple foci of osteomyelitis. Penicillin given every three hours through a tube leading into the abscess cavity kept up an inhibitory level in the blood and cured the patient. Later an abscess of the breast was successfully treated by local instillation of penicillin. The publication by these authors of their successful clinical trials of this method of combining the local action of penicillin with its "protracted systemic effect due to the slow absorption" from abscesses and serous cavities will be awaited with great interest. These authors also injected penicillin into the intrathecal space and again obtained an inhibitory level in the blood. After injection of 120,000 units into two adults and its equivalent into one infant, this level lasted for fifteen hours. The authors do not, however, recommend this intrathecal route until purer forms of penicillin are available and until we know more about the effects of penicillin on brain tissue.

Dorothy Russell and Diana Beck (*Lancet*, 497, April 21, 1945), as a result of their work on the local action of penicillin and sulphamezathine on the brain of rabbits and of a mixture of these two drugs, do not recommend the use of penicillin alone for local application to the brain, although sulphamezathine alone, is very bland in its effects and is in this respect comparable to sulphanilamide and sulphapyridine. The *Lancet* (439, April 7, 1945) states that J. V. Cooke and D. Goldring (*J. Amer. Med. Assoc.*, **127**, 80; 1945) have found that after repeated intramuscular injections of penicillin into children with chronic nephritis, penicillin was found not only in the blood but also in the ascitic fluid and in the fluid of the subcutaneous œdema, although the concentration of it in the cerebrospinal fluid was much lower than that in the blood, and intrathecal injections of penicillin did not increase its level in the cerebrospinal fluid.

Work of this kind has an obvious bearing on the treatment of various forms of meningitis with penicillin. Its use for this purpose has already been noted in *Nature* (**155**, 341, March 17, 1945). The treatment of meningitis with penicillin and sulphonamides was discussed at a meeting of the Royal Society of Medicine (see the *Brit. Med. J.*, 378, March 17, 1945) and some of the difficulties encountered are there noted. Sir Alexander Fleming (*Lancet*, 434, Oct. 9, 1943) successfully treated streptococcal meningitis by intrathecal injection of penicillin by the lumbar route. C. H. Rammelkampf and C. S. Keefer (*Amer. J. Med. Sci.*, **205**, 343; 1943) found that after the injection of 10,000 Florey units penicillin was detected in the cerebrospinal fluid for 31–35 hours, and that it was more rapidly absorbed into the cerebrospinal fluid in subjects with meningitis and was detectable there for twenty-hour hours after the injection. The meningitis subjects showed no untoward effects after intrathecal injection, but normal subjects suffered from headache, vomiting and increased intrathecal pressure. C. Pilcher (*Ann. Surg.*, **119**, 509; 1944) found that intrathecal injection of penicillin causes transitory but not serious meningeal irritation, and is most effective for treatment of staphylococcal and meningococcal meningitis when it is given intrathecally; but that sulphathiazole applied locally to the brain may cause convulsions. D. Genge (*Brit. Med. J.*, 369, March 17, 1945) has reported on the treatment by the intrathecal route of two cases of pneumococcal meningitis.

In an Annotation, the *Lancet* (696, June 2, 1945) notes that R. L. Nelson and L. Duncan (*Bull. Johns Hopkins Hosp.*, **75**, 327; 1944) treated syphilitic meningitis by intramuscular injection of 600,000–4,000,000 units of penicillin with excellent results. They preferred intramuscular injection to the intrathecal route. Very recently, P. Forgacs and R. I. Hutchinson (*Lancet*, 786, June 23, 1945) recorded the cure of one case of meningitis due to *Hæmophilus influenzæ* of the smooth type (Pittman type *b*) by giving a combination of intramuscular penicillin and sulphadiazine. The rough type of *H. influenzæ* is not penicillin-sensitive. A. J. Waking and M. H. D. Smith (*J. Amer. Med. Assoc.*, **126**, 418; 1944) consider that penicillin and sulphonamide given together act better on pneumococcal meningitis than either alone.

Reports of allergic reactions to penicillin are not numerous. W. Mitchie and H. W. C. Bailey (*Brit. Med. J.*, 554, April 21, 1945) point out that they are much less numerous than allergic reactions to the sulphonamides. These authors record one case of sensitivity which was confirmed by application of penicillin to the undamaged skin of the arms, with the production five hours later of a kind of weeping eczema similar to that which had appeared on the wounded leg of this subject after treatment of the wound with penicillin dressings.

For the treatment of septic burns penicillin cream is regarded by the Medical Research Council's Burns Unit working at Glasgow (Med. Res. Council Special Report Series, No. 249. "Studies of Burns and Scalds." H.M. Stationery Office, 1944. 4*s*. net) as being the most certain method of eliminating hæmolytic streptococci and staphylococci. Propamidine creams were also very good but were not so effective as the penicillin creams, of which the formulæ are given. After application of a cream containing about 120 units of either sodium or calcium penicillin per gram of cream, hæmolytic streptococci disappeared from 41 out of 54 burns and did not reappear. One advantage of penicillin creams as compared with sulphonamide creams is that the serious risk of absorption of too large a dose of sulphonamide from the raw burned area is eliminated. Penicillin creams may, however, become infected by airborne organisms, such as *Pseudomonas pyocyanea*, which produces a penicillinase which decomposes penicillin. Prof. H. Berry (*Lancet*, 410, March 31, 1945) suggests that this difficulty may be overcome by the addition of 2 per cent of phenoxetol to the cream. Phenoxetol (see *Nature*, **154**, 631, Nov. 18, 1944) attacks especially some of the Gram-negative and penicillinase-producing organisms which are not affected by penicillin, so that such a cream would not only help to preserve the potency of the penicillin cream but would also enhance its value by attacking organisms in it not sensitive to penicillin.

The administration of penicillin by inhalation of it in the form of an aerosol is described by N. Mutch and R. C. Rewell (*Lancet*, 650, May 26; 1945) and by F. A. Knott and W. H. Clark (*Lancet*, 468, April 14, 1945); R. B. Coles, A. N. Barker and E. A. Robertson (*Lancet*, 720, June 9, 1945) describe their use of penagar, which is 0·5 per cent watery agar containing the required dose of penicillin. It is not sticky, it retains its potency for a month in a refrigerator and can be put up in sterile bottles and collapsible tubes. Penicillin readily diffuses through the agar. The authors quote work which indicates that penicillin given in oils, creams and ointments is released too slowly and its diffusion is not good.

The use of penicillin for gas gangrene has been already noted (*Nature*, **155**, 341, March 17, 1945; and **154**, 677, Nov. 25, 1944). G. H. Fisher, M. E. Florey *et al.* (*Lancet*, 395, March 31, 1945) discuss in an important paper its use against clostridial infections. They argue that penicillin should be given for the prevention of gas gangrene rather than for its treatment when it is established, and record evidence which indicates that an inadequate prophylactic dose of penicillin may cause a serious clinical picture very different from that of gas gangrene or anaerobic cellulitis. After a short interrupted course of penicillin, a profound and protracted toxæmia may result and the diagnosis of gas gangrene may be missed; so that the patient fails to get either gas gangrene antitoxin or further doses of penicillin. The local application of penicillin provided protection unt surgical treatment was possible. C. Grimshaw an L. Stent (*Lancet*, 434, April 17, 1945) report on th successful treatment with penicillin of one case post-operative cutaneous gangrene.

The use of penicillin for the purpose of obtainin bacteria-free cultures of protozoa has been know since 1944. A. H. Mahmoud (*Ann. Trop. Med. Hyg* **38**, 219; 1944) successfully used penicillin t eliminate bacteria from cultures of *Trichomona fœtus* of cattle. Penicillin added to Kerr's mediu for the cultivation of this protozoan to give a fin dilution of 30 units per c.c. eliminated streptococ and staphylococci, but did not remove *Prote pseudovulgaris*. *Tr. fœtus* grew in the absence bacteria, and cultures of it were maintained. Pen cillin has also been used by S. Adler and R. J. V Pulvertaft (*Ann. Trop. Med. and Hyg.*, **38**, 188; 1944 to obtain bacteria-free cultures of *Trichomona vaginalis* of man. Sterile cultures of *Trichomona hominis* can be obtained by the method of S. Adle (*Trans. Roy. Soc. Trop. Med. and Hyg.*, **35**, 219 1942), by which this organism is first grown on medi containing prontosil rubrum and then injected wit prontosil into the peritoneum of mice; whereupo the mice get rid of the remaining bacteria and th Trichomonas can then be grown on sterile media But the method is not applicable to *Trichomona vaginalis*, because this species does not survive in th mice for longer than twenty-four hours. The use o penicillin removes this difficulty and makes bacteria free cultures possible.

G. LAPAGE.

PLANT STUDIES IN SYRIA

IN the scientific world, Syria is gaining prominenc chiefly with several important botanical studie made by the botanists of the Hebrew University a Jerusalem, where a representative Syrian collectio has been compiled in the Herbarium, and by severa expeditions of naturalists in the British Army who have collected specimens of fauna and flora for the British Museum under an Army organization known as the Middle East Biological Scheme. There are four great deserts in the Middle or Near East—Sinai, Negeb (Palestine), Judea and the adjacent Ghor (the 'Avrah), southern Iráq and the Syrian desert (which includes part of Transjordania)—available for investigation.

In the course of recent floristic studies in Syria and Palestine, several stations of an interesting tree, *Pistacia atlantica*, Desf., previously unknown in Asia, have been discovered (Zohary, *Palestine J. Bot.*, Rehovat Series, **3**; May 1940). This is one of the most important North African trees. Thousands of the trees were found by Prof. Zohary covering mountain-sides in northern Syria, and desert specimens were well developed. The tree was formerly more abundant, and is limited to more or less mild Irano-Turanian conditions, at altitudes from −30 m. to +1,400 m. Its discovery in a steppe region not suitable for irrigation culture of other plants has given rise to economic interest.

Prof. Zohary has also identified the "Ghada" tree of travel literature from the north Arabian and south Syrian deserts as *Haloxylon persicum* Bge. (*Palestine J. Bot.*, Jerusalem Series, **1**; 1940). This tree, which is of economic value for fuel, is of considerable phytogeographical interest, for its discovery in these deserts suggests affinities of these deserts with those of Central Asia. It is the only tree dominant for housands of square miles which does not normally receive more than 25 mm. of rainfall annually and s entirely destitute of aboreal plant communities away from wadis, except for *Haloxylonetum persici*; he discovery of this tree also suggests possibilities of economic development of the sterile deserts for fuel, charcoal, food for desert livestock and checking and movements.

Considerable knowledge of the flora of the Syrian desert in general is being accumulated in the Department of Botany of the Hebrew University, where a mass of new material awaits publication and adds onsiderably to the information in Dinsmore's 1932 edition of Post's classic "Flora of Syria, Palestine and Sinai", which the American University of Beirut published. Prof. Zohary has carried on the field tudies of the late Prof. Eig and notable publications have been his "Geobotanical Analysis of the Syrian Desert" (*Palestine J. Bot.*, Jerusalem Series, **2**; 1940) and "To the Knowledge of the Flora of the Syrian Desert" (**1**; 1939) which covers the flora of the central part of the desert, with a rainfall of 95–210 mm. annually, and where 175 species were collected, 75 per cent of which were annuals, sometimes exclusively predominating over immense stretches. Some three hundred new species have been added o the flora of Iraq, of which about two hundred are new to science. The Syrian desert flora has been divided into three territories: Mediterranean, Irano-Turanian (the most important) and Saharo-Sindian with 520, 588 and 239 species respectively; also there are 24 Sudano-Deccanian species, 10 Euro-Sibero-Boreoamerican, and 659 species belonging to two or more groups. Prof. Zohary's paper was the first to treat the vegetative character of the country.

MASS MOVEMENT OF THE WATER SHREW, *NEOMYS FODIENS*

IN the *Journal of the Society for Preservation of the Fauna of the Empire* of June 1945 is a remarkable account by Lady Seton (a keen field naturalist and wife of that well-known observer the late Sir Malcolm Seton) of a movement of the water shrew, *Neomys fodiens*. In it she tells how she saw large numbers of this little mammal swimming up a small stream in Upper Teesdale in what appeared to be a mass migration. Migration is so exceptional among land mammals, if not marine ones (unlike birds in which it is so usual we may say it is the rule rather than the exception), that any instance is of outstanding interest.

Such mammalian migration as occurs is of two types: seasonal on the lines of bird migration, the North American caribou being the classic example, and occasional as in the case of the lemming, *Lemmus lemmus*, with its periodic emigrations from the high fields to the low country. These are seemingly initiated by pressure of numbers and scarcity of food, and the travellers appear to be driven by an urge to go downhill. I have watched the little animals scuttling along, each taking its own course and acting independently of fellow lemmings. I have never seen them moving in droves.

The especially interesting part of Lady Seton's account of the shrews she watched is the mass of animals. This is the more noteworthy for the fact that though *Neomys fodiens* is widely distributed throughout the mainland of Britain, it is usually only met with in sparse numbers. The only reference to water shrews in any number I can find is in Barrett-Hamilton's "History of British Mammals", wherein he refers to them living in family parties, and adds, "Probably, also, the breeding season brings these shrews together in companies, which would account for the party of nine or ten encountered by the late Canon H. B. Tristram on May 6, as well as for a concourse of twenty or thirty observed in Yorkshire by Mr. W. B. Arundel on the 10th of the same month". But these are not described as being on the move. Migration does not appear to have been noted by previous observers in this or allied species. Thirdly, Lady Seton's water shrews were swimming upstream and therefore uphill, though why and where to we have no clue.

FRANCES PITT.

SERUM PROTEINS IN THE ULTRACENTRIFUGE

THE monograph on the proteins of blood serum by Kai O. Pedersen*, from Prof. Svedberg's laboratory at Uppsala, brings home forcibly the present complexity of the subject. Although any one of the usual methods of analysis gives apparently clear-cut fractions, each fraction when analysed by some other method usually turns out to be a mixture. The obvious remedy, to fractionate by each method in turn, is impracticable because some of the analytical methods are difficult to use in a preparative way. After a heroic attempt to achieve a complete separation, chiefly by means of ammonium sulphate with ultracentrifugal analysis, Dr. Pedersen had to confess defeat.

But a wealth of new knowledge has been gained, such as Dr. Pedersen's discovery of the new low-molecular globulin 'fetuin', which was described in *Nature* of November 4, 1944. This is present in fœtal serum of ruminants to the almost complete exclusion of the ordinary globulins and antibodies, which only appear after the animal has received colostrum. The same is true to a less marked extent in rodents and man. The discovery of fetuin is due to the ultracentrifuge, because in salting-out and in electrophoresis it behaves like ordinary α-globulin. A fœtal hæmoglobin has been known for some time; but a fœtal serum globulin was unsuspected.

Dr. Pedersen's study of the 'X-protein' is also illuminating. It has long been known that in undiluted serum some of the globulin sediments at the slow rate characteristic of albumin. This is surprising because a complex of the two proteins would normally sediment more rapidly than either component. Dr. Pedersen's explanation is that there is indeed a complex, but that it contains lipide, which decreases its density and therefore its sedimentation rate. The density is so low in human serum that with added salt the complex sediments upwards and can be isolated. This 'density-effect' cannot be observed in other sera, and similar interactions between apparently lipide-free proteins remain unexplained, so that the story still seems incomplete. 'X-protein' seems to be of physiological importance for lipide transport.

J. ST. L. PHILPOT.

* Ultracentrifugal Studies on Serum and Serum Fractions. By Kai O. Pedersen. Pp. 178. (Uppsala: Almqvist and Wiksells Boktryckeri AB, 1945.) 10 Swedish crowns.

FORTHCOMING EVENTS

Tuesday, August 28

QUEKETT MICROSCOPICAL CLUB (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 7 p.m.—Conversation and the Exhibition of Specimens.

Friday, August 31—Sunday, September 2

SCIENTIFIC FILM ASSOCIATION (at the Technical College, Huddersfield)—Conference on "The Film in Science".

Friday, August 31

At 6 p.m.—Civic Reception by His Worship the Mayor of Huddersfield; at 7 p.m.—Dorothy Grayson: "The Science Film in Education".

Saturday, September 1

At 9.45 a.m.—Mr. W. F. Andrews: "The Film in Industry", 1: "Scientific Film Needs in Technical Training"; Mr. H. Richmond "The Film in Industry", 2: "Film Strip in Technical Training": at 2 p.m.—Mr. Derek Stewart: "The Film as an Instrument of Scientific Research"; at 7.30 p.m.—Mr. Frank Goodliffe: "Film Production".

Sunday, September 2

At 10.30 a.m.—"The Film in Medicine" (Film Show and Discussion); at 2.15 p.m.—Dr. W. T. Astbury, F.R.S.: "X-Ray Adventures among the Proteins and other Molecular Giants"; at 7.30 p.m.—Programme of New Scientific Films.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

DEMONSTRATOR (full-time) IN PHYSIOLOGY—The Registrar, The University, Liverpool (August 31).

CHEMICAL ENGINEER for a responsible appointment on the Technical Staff of an established Firm of Contractors to Gas and Allied Industries—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting C.2646 XA (August 31).

DEMONSTRATORS, one in the DIVISION OF CHEMISTRY, and one in the DIVISION OF HISTOLOGY, at the Royal Veterinary College, Camden Town, London, N.W.1—The Bursar, Royal Veterinary College, The University, Reading (September 1).

ENGINEERING ASSISTANT in the County Architect's Department—The County Architect, 4 Alfred Street North, Carlisle (September 3)

PHYSICIST (male) for position as RESEARCH SCIENTIST in Laboratory on work connected with magnetic properties of alloys—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting A 950.XA (September 7).

ASSISTANT INSPECTORS (2, male) OF FISHERIES in the Department of Agriculture—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (September 14).

EDUCATIONAL PSYCHOLOGIST—The Director of Education, Education Offices, Deansgate, Manchester 3 (September 14)

FOREST OFFICER in the Forestry Division of the Department of Agriculture, Southern Rhodesia—The Official Secretary, Office of the High Commissioner for Southern Rhodesia, Rhodesia House, 429 Strand, London, W.C.2 (September 14).

LECTURER IN THE DEPARTMENT OF MECHANICAL ENGINEERING—The Registrar, The University, Sheffield (September 15).

ENGINEERING ASSISTANT—The Water Engineer and Manager, Spon House, 21 Allesley Old Road, Coventry, endorsed 'Engineering Assistant' (September 17).

COUNTY ANALYST AND OFFICIAL AGRICULTURAL ANALYST—The Clerk of the County Council, County Hall, Maidstone, Kent (October 6).

SUPERINTENDENT OF WORKSHOPS—The Secretary of the Appointments Committee, Engineering Laboratory, Cambridge (October 22)

GEORGE HOLT CHAIR OF PATHOLOGY—The Registrar, The University, Liverpool (October 31).

LECTURER (Grade B) IN PHYSIOLOGY—The Secretary, The University, Edinburgh (November 10).

LABORATORY ASSISTANTS in the Research Laboratories of the Royal Aircraft Establishment—The Personnel Department, Royal Aircraft Establishment, Farnborough, Hants.

MECHANICAL ENGINEERING ASSISTANT, with good experience of Diesel engines—The Mid-Kent Water Company, High Street, Snodland, Kent.

PRINCIPAL OF THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE, Trinidad—The Secretary, Imperial College of Tropical Agriculture, Grand Buildings, Trafalgar Square, London, W.C.2.

HEAD TEACHER OF MATHEMATICS—The Principal, La Martinière College, Lucknow, India.

GRADUATE TEACHER for GENERAL SCIENCE, PHYSICS and CHEMISTRY—The Principal, Technical College, Wolverton, Bucks.

LECTURERS (2) IN MECHANICAL ENGINEERING SUBJECTS to Higher National Certificate standard at the Crewe Technical College—The Director of Education, County Education Offices, City Road, Chester

ASSISTANT MASTER to teach ENGINEERING SCIENCE, GENERAL SCIENCE and MATHEMATICS—The Clerk to the Governors, Grays County Technical School, 22 High View Avenue, Grays, Essex

GRADUATE LECTURER IN ENGINEERING, and a GRADUATE LECTURER with high qualifications in ORGANIC CHEMISTRY to take the subject to A.R.I.C. and Special B.Sc.(Lond.) standard—The Clerk to the Governors, Mid-Essex Technical College and School of Art, Market Road, Chelmsford.

TEACHER OF MATHEMATICS, mainly for Day Technical School—The Principal, Beckenham Technical Institute, Beckenham, Kent.

GRADUATE TEACHER OF SCIENCE (chiefly PHYSICS) with so MATHEMATICS or of MATHEMATICS with some SCIENCE—The Principa Technical Institute, Darnley Road, Gravesend.

TEACHER FOR ENGINEERING SUBJECTS—The Principal and Secreta Harris Institute, Preston.

ASSISTANT LECTURER IN THE METALLURGY DEPARTMENT, and a ASSISTANT LECTURER IN ENGINEERING, for Workshop Technology a Practice, in the Swansea Technical College—The Director of Educatio Guildhall, Swansea

LECTURER IN MECHANICAL ENGINEERING for work up to the standa of the Higher National Certificate, particularly in Theory of Machin and Heat Engines—The Principal, Wimbledon Technical Colleg Gladstone Road, London, S.W.19.

LECTURER IN AGRICULTURE—The Principal, Kent Farm Institut Sittingbourne, Kent.

ASSISTANT TO THE ADVISORY CHEMIST in the Faculty Agriculture and Horticulture—The Registrar, The University, Readin

REPORTS and other PUBLICATION

(not included in the monthly Books Supplement)

Great Britain and Ireland

Royal College of Physicians of Edinburgh. Annual Report by t Curator of the Laboratory for the Year 1944. Pp. 12. (Edinburgh Royal College of Physicians, 1945.) [2

British Society of Animal Production. Report of Proceeding Second Meeting, 24th October 1944, General Topic: The Britis Sheep Industry; Joint Meeting with Institute for the Study Animal Behaviour, 25th October 1944, General Topic: Anim Behaviour. Pp. 106. (Edinburgh: British Society of Animal Pr duction, 1945.) 4*s*. [26

Our Daily Bread: a Dietetic Survey of Wheat and other Cereal By Dr. J. Reilly. Revised second edition. Pp. 44. (St. Ann's Hil Co. Cork: Woodlands Press, 1945.) 1*s*. [26

Conference of Allied Ministers of Education. Draft Proposals f an Educational and Cultural Organisation of the United Nation Pp. 10. (London: H.M. Stationery Office, 1945.) [31

The Knights of St. George: a Scout Movement for Men and Wome Tracts for Adult Scouts, 5: The First Minister of National Cultur with an Outline of his Policy and Programme. By the Chief Knigh Pp. 12. (London: W. Margrie, 1945.) 6*d*. [1

Other Countries

National Research Council. Bulletin No. 111: Manual for th Study of Food Habits; Report of the Committee on Food Habits. P 142. (Washington, D.C.: National Research Council, 1945.) [17

Proceedings of the United States National Museum. Vol. 96, N 3192: Three New Sciaenid Fishes of the Genus Ophioscion from th Atlantic Coasts of Central and South America. By Leonard P. Schultz Pp. 123–138. (Washington, D.C.: Government Printing Office 1945.) [17

Science, the Endless Frontier. A Report to the President by D Vannebar Bush. Pp. ix+184. (Washington, D.C.: Governmen Printing Office, 1945.) [18

University of California Publications. Bulletin of the Departmen of Geological Sciences, Vol. 27, No. 4: An Avifauna from the Lowe Miocene of South Dakota. By Alden H. Miller. Pp. iii+85–10 (Berkeley and Los Angeles, Calif.: University of California Press London: Cambridge University Press, 1944.) 25 cents. [18

Annals of the New York Academy of Sciences. Vol. 46, Art. 1 Animal Colony Maintenance. By Edmond J. Farris, F. G. Carnochan C. N. W. Cumming, Sidney Farber, Carl G. Hartman, Frederick B Hutt, J. K. Loosli, Clarence A. Mills and Herbert L. Ratcliffe. Pp. 126 (New York: New York Academy of Sciences, 1945.) [18

Indian Forest Leaflet No. 77; Preliminary Studies on Improve Wood, Part 3, Compregnated Wood. By D. Narayanamurti and Karta Singh. Pp. ii+11+9 plates. (Dehra Dun: Forest Research Institute 1945.) 9 annas. [18

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NATURE

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CONTENTS

Page
Museums and Art Galleries as a National Service . . 249
Wave-lengths for European Broadcasting . . . 250
Synthetic Rubber from Alcohol. By Dr. W. J. S. Naunton 251
Practice and Science in the Sheep Industry. By Dr. J. E. Nichols 251
A Plan for Decentralizing Administration in Germany. By Prof. W. Fitzgerald . . 253
The Black Widow Spider. By T. H. Savory . . 253
Science in the U.S.S.R.:
  Evolutionary Biology and Related Subjects. By Dr. Julian Huxley, F.R.S. . . . 254
  Crystallography. By Dr. W. A. Wooster . 256
  Pedology. By Dr. Alex Muir . . . 258
The Inferiority Complex and the Paranoid Tendency: With a Brief Reference to Nazi Psychology. By Dr. William Brown 259
News and Views 262
Letters to the Editors:
  Hysteresis in the Adsorption of Water Vapour by Wheat.—Dr. J. D. Babbitt 265
  Cosmic Rays and Kinematical Relativity.—Prof. J. B. S. Haldane, F.R.S. 266
  Raman and Infra-red Spectra of Rock-salt.—Dr. R. S. Krishnan 267
  Effect of Pressure on Thermal Diffusion in Gases.—K. E. Grew 267
  Logarithmic Scales.—F. Campbell Rose . . 268
  Frictional Properties of Wool Fibres.—M. Lipson 268
  An Illusion of Size.—J. Phelps 269
  Occurrence of Hexadecatrienoic Acid in the Glycerides of Rape (*Brassica napus* L.) Leaf.—Dr. F. B. Shorland 269
  Rate of Entrance of Ammonia into Muscle Fibres in Relation to Carbon Dioxide Tension.—Prof. E. J. Conway and P. T. Moore . . 270
Royal Society of Canada: Annual Meeting . . . 271
Mode of Action of Penicillin. By Dr. G. Lapage . 272
Radio Waves from the Sun 273
New Buildings of Bell Telephone Laboratories . 274

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MUSEUMS AND ART GALLERIES AS A NATIONAL SERVICE

A PUBLICATION of considerable importance to museum and art gallery officials and committees, and all municipal and county authorities contemplating the establishment or reorganization of museums and art galleries, appears in the *Museums Journal* of June 1945, pp. 33–45. Entitled "Museums and Art Galleries in the Post-war Period: a Survey and Proposals by the Museums Association", it sets forth the contents of a document submitted last May to the Minister of Reconstruction after a discussion had taken place between representatives of the Ministry and the Museums Association, London.

This document surveys the present position of the museums and art galleries of Great Britain, and makes far-reaching proposals for their future development. It points out the general inadequacy of these services outside London, and calls for an all-round improvement of existing buildings, administration, staffs and finance, wherever necessary. The financial figures given for 1938 are illuminating: in that year, approximately £1,000,000 was spent on the thirteen national institutions in London, while the 770 institutions in other parts of the country received about £450,000. In other words, the average expenditure on museums and art galleries in the provinces only amounted to about threepence per head of the population. These figures do not include the national museums in Edinburgh and Cardiff which, like those in London, are supported by the State. Further analysis shows that, of the provincial museums, as many as 470 were—and presumably continue to be—in receipt of incomes of less than £300. (Nearly half of these, however, are attached to libraries or colleges and have not a separate income, so that their financial position may not be so bad as at first appears.) Nevertheless, these figures serve to expose a further unsatisfactory condition relative to the welfare of the average British museum, namely, the entirely disproportionate and low rates of pay for work which requires a high standard of education, specialized training and technical ability. Except in the national museums and in those of the larger provincial centres, a director's or curator's salary, for example, is (to quote from the document), "always among the lowest given to the chief officers of the corporation, and it is more often than not smaller than that given to deputies in other departments". In the case of officials of smaller museums, it is sometimes even less than that allotted to the local dustmen! Consequently, little but a devotion to the work encourages men and women of the right calibre to take up museum or art gallery work at the present time.

Section V of the document is particularly concerned with the ways and means of improvement of the museum services of Britain as a whole. It is recognized that the much-needed development rests upon the provision of adequate funds; for new or reconstructed buildings, staffs adequate in training and numbers, and a wide range of facilities and equipment are involved. Suggestions are made regarding the method of financial support, the most favoured being the establishment of a Museum and Art Gallery Grants Board on the lines of the University Grants Committee. The Board would consist of experts sympathetic with museum and art gallery problems, and these would "assess schemes, allocate grants, and impose conditions which, under a scheme of inspection, would ensure the maintenance of suitable standards, and so assist in raising the status of museums and art galleries throughout the country".

Museums and art galleries form cultural centres: they educate, and provide for the intelligent use of leisure; they are in contact with a very wide public, and are, therefore, in a particularly favourable position for the diffusion of knowledge based on scientific principles: they have (or should have), therefore, a very definite place within any intelligent community. In this light, the direct appeal for government support and encouragement which this document puts forward is worthy of the closest consideration.

WAVE-LENGTHS FOR EUROPEAN BROADCASTING

THE wave-lengths or frequencies used by broadcasting stations in Europe in normal times were the result of discussions and conferences held under the auspices of the International Broadcasting Union formed about twenty years ago. It was as a result of the activities of this Union that the Lucerne plan was formulated and put into practical operation during the night of January 14–15, 1934, when a general re-distribution of wave-lengths of European broadcasting stations was conducted by the responsible organizations. In April 1939 a revised plan was drawn up in the form of the Montreux Convention, which was signed by the representatives of thirty-one States; and this plan provided for certain changes in wave-length and power of European broadcasting stations to come into effect in March 1940. Although the operation of this plan was in any case prevented by the War, it is doubtful whether it would have been successful had it been applied; for, as Sir Noel Ashbridge remarked in his presidential address to the Institution of Electrical Engineers in 1941, these international conferences were rendered very difficult by the various political influences involved. Sir Noel expressed the hope that, after the War, it would be possible for a well-based wave-length plan for Europe to be built up on rational principles with due regard to technical facts.

It is with the view of rendering assistance towards this objective that the Radio Industry Council has recently issued a report entitled "Post-War European Broadcasting", prepared by the technical committee of the British Radio Equipment Manufacturers' Association (Radio Industry Council, 59 Russell Square, London, W.C.1). This report outlines a new proposal, based upon technical considerations and on appreciation of the ordinary listener's requirements, for the allocation of wave-lengths among the thirty European countries. The proposal aims at providing for every nation at least one, and in most cases two, programmes which adequately cover the entire country; in addition, a system of regional programmes would be provided to meet local requirements, and in particular the major language groups in each country. The whole scheme would also provide for every listener good signals from some foreign stations in addition to his own national and regional programmes.

For the plan to be successful in attaining these objectives, it is clearly necessary to arrange wave-lengths in relation to the location and power of the transmitters, so as to minimize interference between any two stations, and to permit reasonable quality of reproduction from receivers in all parts of the service area of each station. Power as well as wave-length would have to be specified in order to ensure good service over each area, while still avoiding serious interference with other transmitters.

As a basis for the proposals put forward in the report, the radius of the service area or coverage of a broadcasting station is defined as the distance to which the ground-wave signal is greater than 2 mV./metre, and the ionospheric or sky-wave signal which causes fading is never more than a certain value to be selected on the basis of experience. Based upon such assumptions, the report states that the primary service area of medium-wave broadcasting stations is a circle, the radius of which in miles is approximately equal to one-quarter of the wave-length in metres. Proceeding along these lines, the main national allocations are obtained by using the whole of the existing long-wave broadcasting band of 156–288 kc./s. (wave-lengths 1,040–1,920 m.) together with the extension envisaged in the Montreux plan of 344–432 kc./s. (695–873 m.). In this extended long wave-band, sufficient frequency allocations are proposed, at intervals of 11 kc./s. between stations, to provide two national programme services for each of the thirteen larger countries; European Russia being regarded as two countries as it has two main languages. For the seventeen smaller countries the size of which does not require the use of long waves to secure effective coverage, the national programmes are allocated to some, but not the whole, of the band between 552 kc./s. and 1,157 kc./s. (260–544 m.). The remainder of the medium wave-band, up to 1,553 kc./s. (193 m.), with one or two exceptions, and the portions of the above band not used for national services, are to be divided up for regional purposes, common-wave working being envisaged for stations separated by a distance of at least 1,500 miles. The scheme suggests provision for eleven regional transmitters in Great Britain and Northern Ireland in addition to two national transmitters working on 178 kc./s. (1,685 m.) and 222 kc./s. (1,350 m.).

In brief, the proposed plan claims to give the following facilities: two adequate national channels for every country; an increase in the frequency separation from 9 kc./s. to 11 kc./s., resulting in a material decrease in interference; and a better regional service even in England, and vastly better for the majority of Europe. If the complete scheme is to be satisfactory, however, it is emphasized that it is essential to have better control and regulation of the power, frequency and modulation of broadcasting transmitters all over Europe than has been the case in the past.

In presenting the report summarized above, the Radio Industry Council makes it clear that its proposed solution of the problem is by no means rigid or final, since considerable elasticity is offered in the exact wave-length allocations without affecting the general scheme. It is, however, commended to the earnest consideration of those who are able to influence the future development of broadcasting, in the belief that the present phase in Europe presents a valuable opportunity and, in the view of the British radio engineers represented by the above Council, an obligation to correct past mistakes.

SYNTHETIC RUBBER FROM ALCOHOL

Synthetic Rubber from Alcohol

A Survey Based on the Russian Literature. By Anselm Talalay and Michael Magat. Pp. xiii+298. (New York: Interscience Publishers, Inc., 1945.) 5 dollars.

THIS book is well written and printed, free from typographical mistakes, and generally very readable. It is divided into four chapters. The first chapter deals with the chemistry of the Lebedev process for preparing butadiene from alcohol, the second with the technology of the process, the third with the fundamentals of polymerization, including a sub-section on the technology of sodium polymerization, and the fourth with the physico-chemical properties of the polymer, including a most important section on determining the structure of the polymer. While the book as a whole was a co-operative effort of both authors, Chapters 1 and 2 were mainly the responsibility of A. Talalay and Chapters 3 and 4 of M. Magat. It is to be regretted that a further chapter dealing with Russian experience in handling polybutadiene in the rubber factory was not added. Useful author and subject indexes are appended.

The writing of the book is justified by the fact that so few English-speaking technical men can read Russian. A survey must always suffer from lack of authoritative information, and this book is no exception. While the authors have done a good piece of work in bringing together so much valuable information locked away in journals difficult to obtain and more difficult to translate, the reader has the impression that the authors are no better informed on what real progress has been made in the development of synthetic rubber in the U.S.S.R. than he is himself.

This doubt arising from the reviewing of the work of others is quite frankly expressed in the text by the use of the word 'apparently'. This is really a great virtue on the part of the authors, since less honest writers might have been tempted to identify their own views with those of the original authorities.

It is also regrettable that Russian references to more recent work (most of the references are more than ten years old) are not very numerous.

Attention should be directed to the statement on p. 145: "the Germans soon abandoned this method of polymerisation" [sodium polymerization]. This is, of course, untrue since the Germans only abandoned it for the production of products which could be made more efficiently by the dispersion technique. Conversely, more attention could have been paid to the reasons why emulsion polymerization offered difficulties in the case of straight butadiene polymerization.

The practical side of the book (that is, the technology of production) deals almost exclusively with the production of butadiene and polybutadiene. This, naturally, is to be expected from the second part of the title of the book. The reviewer is somewhat surprised that the authors have not mentioned in their introduction Smirnov's book, which covers largely the same ground, at least from the technological angle. It is also rather to be regretted that the title (save for the second conditional part) and contents may lead beginners in the field to the wrong conclusion that polybutadiene is the most important rubber produced from alcohol. Buna *S* (or its analogues) is, of course, the most important synthetic rubber produced from alcohol in the past and present, although there are some indications that polybutadiene may be the most important in the future. This possible misunderstanding might have been avoided by employing a more limited title such as "Polybutadiene Rubber from Alcohol". The authors have, indeed, pointed out that the co-polymers with styrene and acrylonitrile are important, but, in the view of the reviewer, with insufficient emphasis. It is true that some specific information regarding the American processes is still restricted, but no one could deny that far more has been published regarding the general position of synthetic rubber development in the United States than in the U.S.S.R.

A considerable amount of the material contained in the theoretical sections of the book is derived from non-Russian sources, and this makes it even more regrettable that more attention was not given to the production of Buna types from alcohol in the early technological sections of the book. A correspondingly large proportion of non-Russian references in the early part of the book would have made this possible.

The book is essentially one for the chemist interested in the development of synthetic rubber. It is feared that the average rubber technologist will find the treatment of the subject too academic. On the whole it is a book to be recommended.

W. J. S. NAUNTON.

PRACTICE AND SCIENCE IN THE SHEEP INDUSTRY

(1) The Merino

Past, Present and Probable. By H. B. Austin. Second edition. Pp. 247. (Sydney: Grahame Book Co., 1944.) n.p.

(2) Sheep

By J. F. H. Thomas. With Chapters by Moses Griffiths, Martin Jones and A. R. Wannop. Pp. 196+44 plates. (London: Faber and Faber, Ltd., 1945.) 15*s.* net.

"THE sheep has golden hooves, and wherever the print of them appears, the soil turns to gold." This old Swedish proverb is quoted by Mr. Austin; Mr. Thomas could equally well have taken it for one of his texts. The former is concerned with the role of the Australian Merino stud sheep in leading commercial wool production; the latter covers the great complexities of breeds, crosses, methods of management, and diseases which are compounded in the sheepbreeding industry of Great Britain.

Both authors are practical men who have earnestly set out to assess the contributions that science has made, makes, and could make towards technical progress in matters of sheep-breeding and husbandry. Both are optimistic regarding the future of the sheep industry, with important reservations as to policies and methods. Both are quite ready to enliven their matter by interjecting subjective views, criticisms and personal opinions. While each has written primarily for practical men specially interested in the industry of their own country, the scientific reader can be advised to regard the books as complementary, to forgo criticisms of many of the obvious weaknesses and deficiencies, to accept the sincerity of the authors' arguments, and to appreciate the valuable contributions each makes to the literature of the livestock industries.

(1) Breed history is a proper background for the study of breeding methods, and Mr. Austin has performed a remarkable service in amassing so much in the way of contemporary records, opinions and data on those strains of sheep which have gone to make the modern Australian Merino. His main interest is focused upon the history of the important strain of Peppin Merinos, so that his history does not cover all, or even most, of the other varieties or sub-breeds of Merino. In this sense the book appears somewhat unbalanced, but it would have been an excessively formidable task to give such a history of all Merino strains. However, it is certainly safe to say that this account can never be neglected by anyone wishing to learn the story of any kind of Merino. Apart from the quotations from the literature, the author's analyses of the trends and dictates of fashion or whim in changing breed type and form are of special interest and fascination, enhanced in value by the remarkable collection of illustrations showing the different stud types favoured in the various eras of Merino breeding.

The fashion in one era is fiercely attacked. The disastrous craze for the "heavily wrinkled horrors" of the Vermont type which pervaded much of Australian Merino breeding for about thirty years from 1890—although it had previously begun to ebb in the American home of this strain—had seriously disturbed the steady development of the plain-bodied Merino sheep yielding a sound and fairly uniform fleece of good commercial wool. Though this craze has now passed and been replaced by more sensible breeding aims, Mr. Austin claims, with good evidence, that the mating and selection methods introduced and publicized by the Vermont enthusiasts have left an unfortunate legacy of belief in the value of "corrective matings". He argues convincingly that there has been no great genetic improvement in the Australian Merino, that there is an urgent need for the establishment and wide use of objective tests of wool-producing ability, and that a near-worship of pedigree must be replaced by a realistic and thorough application of performance and progeny tests.

In support and elaboration of this last argument, and in his hearty enthusiasm for applied genetics, Mr. Austin devotes four of his thirteen chapters to a discussion of the principles of genetics and their application to Merino breeding. He has made a serious attempt to understand some of the recent advances in this branch of biological science, but unfortunately he appears to have gained more respect than true understanding or discrimination Unfortunately, because while the geneticist will not be misled by his discussion, or by the illustrations and diagrams from well-known text-books here reproduced as hallmarks to the accompanying matter, the layman might. Yet, in spite of this danger that the book might be accepted by some breeders as an authoritative statement of genetical fact and theory, it is significant and symptomatic that so much of the genetical approach should be included and presented as a practical means towards the future development of this important breeding industry.

(2) Mr. Thomas, on the other hand, gives us only an account of the actual application of progressive methods in everyday sheep husbandry in Great Britain, and incidentally shows forcibly at times how the scientific worker has neglected some important phases of the farmers' problems. His book is "an attempt to give a picture of the sheep and sheep farming of Great Britain at the present time". While his three collaborators deal with the special regional aspects of sheep farming in Wales, in the mountains and hills of Scotland, and in the Scottish Border counties, he covers the wider field in a practical, and often provocative, manner. Mr. Thomas is happiest when dealing with the methods and complexities of the industry at large as judged against the background of an intimate knowledge of management under that most intricate system of sheep husbandry, the arable flock. The all-too-short outline of his own practices is a highly valuable contribution. When, however, he sets out to deal with specific technical subjects, as in Chapter 5, "Flock Hygiene: Diseases and Other Causes of Loss", he is not so happy and his presentation will appear weak to the specialist. Yet even in this chapter his concluding paragraph shows his whole attitude directly and convincingly: "From this long and depressing catalogue of the ills to which sheep are subject, one salient fact emerges—many of the causes of loss in sheep are directly due to man's ineptitude. Good management and good shepherding result in healthy flocks, a minimum of loss, contented sheep, and less harassed flock-owners".

Sheep and sheep-farming methods are not the exclusive theme; the picture given of the industry is that of only a part of British agriculture. The author believes, deeply and strongly, in livestock as a most potent factor in the general agricultural situation of Great Britain. He argues for an expansionist policy for agricultural production, in which he sets as a reasonable target 31,000,000 sheep in 1949, some six million more than we had in England, Scotland and Wales in 1939. For the development of the sheep industry he requires firm governmental action and a progressive agricultural policy, with stabilized prices, guaranteed markets, and organized marketing as "obvious essentials". Intensified and extended research and technical education are also needed. But this is not all; there is the other side, on which the sheep farmer must "accept responsibility by striving in every way to improve his methods of breeding and management". Mr. Thomas means, and plainly reasons in this stimulating book, that "the future of our sheep industry depends upon the team-work of the State, the flock-owner, and the shepherd".

J. E. Nichols.

A PLAN FOR DECENTRALIZING ADMINISTRATION IN GERMANY

The Regions of Germany

By Dr. Robert E. Dickinson. (International Library of Sociology and Social Reconstruction.) Pp. ix+175. (London: Kegan Paul and Co., Ltd., 1945.) 10*s.* 6*d.* net.

HAVING in mind the need to curb the aggressive strength of a united, highly centralized Germany, the author claims for his regional scheme the means of preventing the continued domination of the country by Prussia. His advocacy of a partition of Germany into autonomous or semi-autonomous areas leaves doubt, unfortunately, as to whether a federated or a confederated Germany is recommended, and there is vagueness as to the extent of devolution proposed. Indeed, the proposed relationships of the individual regions with the central government and with each other are scarcely, if at all, discussed, despite their importance to the statesman and administrator, for whom presumably the book is primarily intended; while, in view of the author's fear of Prussian hegemony, we should expect an alternative to Berlin to be proposed as the supreme headquarters of government.

Economic geography provides the principal criteria for the author's system of regions. Social considerations, by contrast, are granted negligible importance. Moreover, the emphasis laid on partition tends to obscure the closeness of the economic and social associations which draw the provinces of Germany together, and if the advice offered were to be followed it might well result in the 'balkanization' of Central Europe. The experience of the Soviet Union, which may usefully be cited on this point, is that nations (for example, the Ukrainian and the Belorussian) are stoutly opposed to the subdivision of their territories into 'economic regions' for purposes of convenience in administration. In the same way, a too-ruthless departure from the boundaries of traditional units is not likely to gain the willing sanction of the German people.

Although it cannot be conceded that the author's purpose is fulfilled—and considerable ambiguity does not help the reader—this essay on the economic geography of Germany should prove useful to students, especially those without direct access to the work of the German regional geographers, whose authority Dr. Dickinson freely acknowledges. The confidence of the reader would be increased by the careful revision of inaccurate or loosely worded statements, only one or two of which are here indicated. The geographical interpretation in the text of the population density map (p. 37) is not borne out by the evidence which the map itself provides. The two 'belts' of high density to which particular reference is made are by no means obvious, even if due allowance is made for generalization. Admitted that geography suffers from a paucity of technical terms, it should nevertheless be possible to avoid such a statement as (p. 70) "The belt has about 3½ million inhabitants. . . . It falls into 3 belts". The suggestion that the aggressions and barbarities of German policy are attributable to a wicked Prussia which, by its domination, has prevented the development and expression of the latent democracy of non-Prussian Germany, is confuted by the history of the totalitarian Nazi creed, in which the part played by Bavaria does not seem to have been inconsiderable.

W. FITZGERALD.

THE BLACK WIDOW SPIDER

Black Widow

America's Most Poisonous Spider. By Raymond W. Thorp and Weldon D. Woodson. Pp. xi+222+16 plates. (Chapel Hill, N.C.: University of North Carolina Press; London: Oxford University Press, 1945.) 18*s.* 6*d.* net.

THE 'black widow' has for long been the popular name of the American spider *Latrodectus mactans*, notorious above all others for the reputed virulence of its bite. In 1934 there was a remarkable increase in the numbers of the species, and the recorded cases of spider-bite, or arachnidism, so alarmingly multiplied that the 'black widow' acquired a 'news value' in the popular Press. Messrs. Thorp and Woodson then undertook a comprehensive study of this spider, the results of which are contained in this book.

It opens with a somewhat irrelevant account of spider myth and legend, including such extremes as the words of the Koran and the story of Little Miss Muffet, followed by a most interesting chapter on the Tarantula and a very incomplete survey of other poisonous spiders. Thereafter the book deals only with *Latrodectus mactans* and other species of the genus which occur in other parts of the world.

An admirable historical account of medical experience occupies eight chapters. After the earliest recorded spider-bite in America, on September 3, 1726, the first extensive collection of cases was published in 1901 by Dr. C. C. Browning. A quarter of a century later, Dr. Emil Bogen of Los Angeles produced the first of his well-known papers on arachnidism, establishing it as a clinical entity and reviewing all available information. Dr. Bogen, who has continued this work, contributes a foreword to this book, and is acknowledged by its authors to have been most helpfully associated with their studies. There are now records of 1,291 cases, involving 55 deaths. Thus it is fair to say that arachnidism, like hydrophobia and the rattlesnake bite, causes a few deaths each year; but it is essentially avoidable and is surprisingly infrequent in view of the wide dispersal of the spider. We are told that by far the commonest cases are those in which the spider's web has been spun beneath a lavatory seat and the patient has been bitten in the genitalia; that the poison spreads with extreme rapidity; that it particularly affects the nerves; and that the very severe pain is felt throughout the body; that wrong diagnosis is frequent; and that more than ninety different remedies or treatments have been recommended.

The latter half of the book is less scientific. It includes a review of the public interest in the spider, which mentions several trivialities, an elementary account of the class Arachnida and a popularly written description of the habits of the 'black widow', in captivity and elsewhere, as observed by the authors. There is also a survey of the distribution of the spider, which resists equally the cold of Denver and the heat of California, the drought of Yakima Valley and the moisture of Alabama, and has been found from sea-level to an altitude of 8,000 ft.

Some rather inconclusive suggestions for natural and artificial control of the 'black widow' bring to an end an interesting and generally successful example of popular treatment of a scientific subject.

T. H. SAVORY.

SCIENCE IN THE U.S.S.R.*

EVOLUTIONARY BIOLOGY AND RELATED SUBJECTS

By Dr. JULIAN HUXLEY, F.R.S.

IN the U.S.S.R., a convergent attack on the evolution problem is being made from many angles simultaneously—from that of genetics, of taxonomy, of ecology, of cytology, of field studies and behaviour, of mathematical analysis, of comparative anatomy, of palæontology. In this, the U.S.S.R. resembles Britain, the United States and other countries, though it is interesting to find that during the War a good deal of the work has been carried on independently, in total or partial ignorance of research elsewhere. The approach has in general been along the same neo-Darwinian lines, involving acceptance of neo-Mendelism, as in Britain and the United States, though perhaps with even greater emphasis on strict selectionist principles. This is all the more interesting, since in the U.S.S.R. neo-Darwinism is in sharp contrast with the revolutionary views of the botanist and agriculturist Lysenko. Lysenko's conclusions and theories demand an article to themselves. Here we can only say that though Lysenko claims to be a true Darwinian, his contentions involve a sweeping form of Lamarckian inheritance, as well as remarkable effects of scion on stock in grafting, and their hereditary transmission. Further, he expressly states his disbelief in Mendelism or any other particulate principle of heredity. Lysenko is in a powerful position, both scientifically, as president of the Lenin All Union Academy of Agricultural Sciences, and politically, as vice-chairman of the Supreme Soviet. However, in spite of this, the neo-Mendelian and neo-Darwinian selectionists continue to turn out large quantities of excellent work (thus disproving the contention sometimes advanced by non-Russian men of science, that scientific theory in the U.S.S.R. is always subject to political considerations). Indeed, in Lysenko's own Institute are to be found research workers on *Drosophila* genetics and cytology, and a former member of the staff of Vavilov, the eminent plant geneticist (now dead), who was Lysenko's most prominent antagonist before the War.

In what follows, I propose to mention some of the work in the more important fields of research which I came across during our two weeks in the U.S.S.R., in the hope that this will facilitate that renewal of contacts which is so desirable after the isolation caused by the War.

Work on *Drosophila* is in progress in numerous institutions. In Dubinin's Laboratory of Genetics in the Institute of Cytology (Moscow), Dubinin himself is studying the selective effects of various inversions in natural populations. One inversion has a selective advantage over the normal at low temperatures. Several others are at a *disadvantage* at low temperatures, and are much more numerous in urban conditions: the result is to produce a balanced polymorphism as between urban and rural populations, similar to that found with industrial melanism in moths, though the selective agencies are quite different. Berg and Dubinin have also found a seasonal balance as regards the mutant wing-vein character *extra-analis*. All the polygenes responsible for this character are in one chromosome, a state of affairs which Dubinin maintains must be due to selection. Dubinin has also some very interesting work on mutation-rate—its general control by selection; the existence of strains highly mutable for yellow; etc.

In conversation, Dubinin recalled the fact that in 1931 he (with Romashov), had, simultaneously with Sewall Wright but quite independently, enunciated the principle of non-adaptive evolution in small populations. (Unfortunately, he used the cumbersome phrase 'genetical-automatic processes', and the convenient American term 'drift' has quite superseded this.) Siderov is studying the position-effect with regard to yellow. The frequency of yellow mosaics is related to contiguity of the yellow locus to the 'inert' region of the chromosome; it is also related to development—thus the manifestation of yellow-mosaicism is less frequent on the head than on the body. Other problems of physiological genetics will be investigated by Rappaport on his return from service.

Work on mutation is also being carried on by Shapiro in Academician Serebrovsky's Department of Genetics in the University of Moscow (though mainly on a new genetic object, the melichid fly *Dermmetopa*); by Olenov in the Genetics Department of the Roentgen Institute in Leningrad; and by Miss Berg in Schmalhausen's laboratory in Moscow. Berg is also doing interesting work on natural populations, especially on the evolution of dominance, and on the effects on different mutants of the varying types and intensities of selection which prevail at different periods of the annual cycle.

In Academician Lysenko's Institute of Genetics, apart from Lysenko's own work (with Glushchenko and others) on grafting and the inheritance of its effects, which I do not propose to discuss here, Prokofieva is making an extremely interesting study, from the cytological aspect, of the metabolic cycle of chromosomes (which she has christened 'heterocyclicity'), notably in regard to the difference between the paternal and maternal genomes. Nujdin is working on *Drosophila* here, and on his return from military service, Belgovsky will continue his work on the pure genetics of *Drosophila*.

In mathematical genetics and evolution theory, important work is being done by Kolmogorov, Malinovski, Smirnov, Ignatiev, Romashov, Schmalhausen and others. Schmalhausen is working on what he calls 'stabilizing selection' and the different reaction-norms to be expected in different types of environment.

It was of great interest to find that the Pavlov Institute at Koltushi (Leningrad) has a department devoted to the genetics of behaviour. Here, Dr. Masing is studying the inheritance of phototaxis in *Drosophila*, and has also obtained valuable results on the genetic basis of egg-laying preferences, which help to explain the origin of 'biological races' and monophagous species. Meanwhile, Promptov is studying the effects of environment and of heredity on activity and other aspects of behaviour in finches. This, I believe, is the only work that has been done on the genetics of behaviour in wild bird species. The study of the inheritance of temperamental types in dogs, begun under Pavlov, will be continued, and is to be extended by similar work on pure breeds, the material so far having been genetically quite heterogeneous.

In the Institute of Cytology, Sacharov, using colchicine, has produced a valuable new tetraploid form of buckwheat. He has also found that in an artificial poppy tetraploid, the tapetal cells of the anthers remain octoploid, as in the normal diploid—an interesting example of regulation. Frolova, as well as studying the cytology of these tetraploids, is doing work on the digestion of different parts of chromosomes by different enzymes and other agencies, which should be of general importance. Peshkov has obtained what appears to be conclusive evidence of chromosomes and their division in a bacterium (a giant form, *Karyophanon*), and is also studying the peculiar endomitosis of *Chara*. In Navashin's laboratory in the same Institute, a giant and highly fecund tetraploid of a valuable rubber-producing composite has been artificially produced. Navashin himself is now studying the dynamics of mitosis in *Crepis*.

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* Continued from p. 228.

In the Institute's Laboratory of Experimental Embryology (besides interesting work on morphogenesis which cannot be discussed here) Astaurov, working on silkworms, has obtained both parthenogenetic males and females. Schmidt is continuing his well-known researches on the nemertine *Lineus*, which showed the existence of two modes of development, one where the eggs are larger and all develop, producing Desor larvæ and green adults, and the other where the majority degenerate after early segmentation, and are ingested by the remainder, which develop into large-mouthed larvæ and red adults. He now considers these as separate but close species, differentiated after genetic isolation. In the red species (*L. ruber*), he now finds that the percentage of degenerating eggs is the same (87 per cent) in two widely separated subspecies with slightly different-sized eggs and markedly different egg-totals. He suggests that this depends on a genetic mechanism involving balanced lethals—if so, a remarkable case of lethals being utilized to produce an adaptive result.

'Close species' in plants and other botanical species-problems are being studied by Rosanova in the University Genetics Laboratory. Here also, Khostova has been independently repeating some of Lysenko's work on the effects of grafting on tomatoes, I understand, with largely negative results; Alikhanyan is studying structural mutations; and the director, Serebrovsky, has been working on the genetics of parasitoids for practical purposes. Among other results he has obtained a wingless strain of *Sitotroga* to serve as food (host) for the useful *Trichogramma*; this is of importance as reducing the danger of spread of *Sitotroga*, which is a pest.

In Schmalhausen's laboratory, Mashkovtsev and his colleagues are doing a good deal to generalize the modern thesis that courtship and display (and other external stimuli connected with the breeding habitat) have a physiological effect in ripening the female gonads in birds and mammals.

Very interesting work is being done by C. F. Gause. Employing ciliates, he has given the first experimental proof of the efficacy of organic selection. He finds that both salinity and temperature changes normally induce modifications in body-size; when conjugation is induced, segregants appear with a large range of body-size, but only those survive which are of the same type as the modifications. Gause is now devoting himself mainly to medical research on gramicidin, but hopes to give some of his time to evolutionary studies.

Alpatov has shown that the correlation which he had previously established between tongue-length and latitude in bees is found only in the workers, not in queens or drones, and is thus presumably an adaptation to the flowers visited. He proposes to extend this work to bumblebees. He has also established the important fact that the irreversibility of the transformation of the head-louse to the body-louse is a selection effect. The head-louse shows a great range of variability; in the five or six generations required to transform it into the body-louse, heavy mortality occurs and the variability is reduced, so that the reverse process is impossible. The body-louse is thus a specialized type, produced by a selection which Alpatov considers is mainly one for tolerance of lower temperature.

Work on the genetics of cancer is being done in the Genetics Department of the Oncological Institute in Moscow under Martinova, and on the genetics of coarse fish by Romashov in the Genetics Department of the Freshwater (Pond) Fish Institution in Moscow. I was informed that information on the genetics of fur-bearing animals and on their variation and polymorphism in Nature was to be obtained from the Central Fur Laboratory of the People's Commissariat for Foreign Trade (Profs. Petrayev and Manteufel), but was unable to make contact with them.

In taxonomy, excellent work is being done, both in the University Museum of Zoology, Moscow, and in the large Museum of Zoology in Leningrad (famous for its specimens of mammoth and woolly rhinoceros with skin and hair), to which is attached the Zoological Institute of the Academy.

In Moscow, Dementiev told me that he had been so stimulated by the publication of the "Handbook of British Birds" during the War, that he and a team of collaborators are now preparing a handbook of the birds of the U.S.S.R., which will aim at very full ecological treatment. This will be a formidable task, as there are 675 species to cover; but it will be of the greatest value to ornithology and to taxonomy in general. Heptner, the mammalogist here, is pursuing zoogeographical studies, as is Turov. Heptner is also working on polymorphism in *Mustela*, *Myospalax*, *Arvicola*, etc. The marten (*Martes martes*) and the sable (*M. zibellinus*) show a 'hybrid zone' very similar to that between the carrion and hoodie crows. There is also a chair of zoogeography in the University of Moscow, held by Bobrinskoi, who has just published a book on the mammals of the U.S.S.R., while Puzanov of the University of Gorki has published a text-book of zoogeography. Lukin, professor of biology at the University of Kharkov, is also working on biogeography and has published a book on Darwinism and the geographical variation of organisms.

In Leningrad, much work is being done on the taxonomy of the various main groups of animals, and numerous books are being published, including many volumes of the detailed Fauna of the U.S.S.R. (chiefly anatomical and systematic). At the Leningrad Museum an interesting feature (unfortunately rare in Britain) was the linking of museum systematics with physiology and ecology. Thus the entomologist Kushentsov is writing a book on the comparative physiology of insects, and Rubtzov works chiefly on the ecology of Diptera. The curator of mammals, Vinogradov, is also professor of vertebrate systematics and ecology in the University of Leningrad, and maintains a field station for his students. In the University Department of Entomology, Shvanvich has perfected a new method for demonstrating the true value of 'ruptive' coloration in Lepidoptera, in breaking up the flat plane of the wings into a number of apparently different levels: in some cases the result simulates a foreground of grass stems against a dark background. He has also made a valuable study of the evolution of wing pattern within single families—a veritable comparative anatomy of pattern and its elements.

To return to ecology, the leading animal ecologist in the U.S.S.R. is Formosov. Unfortunately, he and his staff were away in the field at the time of our visit, so that I had no opportunity of hearing of their current researches, nor did I make contact with Sinskaya or other plant ecologists. Attached to the Zoological Gardens in Moscow is a small but interesting institute, the Laboratory of Experimental Ecology, under Kalabukhov. He and his assistant Afonska are making quantitative studies of the activity, temperature preferences, respiration, and oxygen consumption of various mammals—bears, foxes, field mice, hamsters, martens, etc.—and finding adaptive correlations with local environmental conditions. Work is also being done on the change of colour to winter white in *Cricetulus* and *Lepus*.

At the Museum Darwinianum in Moscow, in addition to the remarkable exhibition methods (which include a large number of striking paintings and sculptures by the artist Vatagin), Kohts, the director, has an extraordinary collection of aberrations in various species of birds and mammals. The most interesting are in blackcock, where more than 200 million specimens from the markets for some four hundred years had been gone through! As a result, Kohts is able to say that a dilute ('blue') form occurs once in about 2½ million specimens, a form with checked black-and-white belly once in 10 million, and so on. Mme. Kohts is continuing her work on the behaviour of chimpanzees (a subject which is also being studied, with interesting results, at the Pavlov Institute at Koltushi).

Boris Zavadovsky also has a Museum of Evolution in Moscow, but this is more popular and takes in more general biology. It comprises a number of living exhibits. Zavadovsky writes a good deal on theoretical biology and on Marxism in biology, as well as doing practical work on artificial insemination, on pregnancy tests, and tests for the sex of unborn mammalian offspring.

In general, much less research is being carried on in university departments than in the special institutes of the Academy of Sciences and other non-university institutions. However, the disparity does not seem to be so great in biology as in the physical sciences. Genetics is at present taught only in the University of Moscow: specially able students from other universities may be sent to Moscow to take this course. Genetics is studied during the last two and a half years of the five-year undergraduate course in biology; there are now about twenty genetics specialists. During their final year, students are encouraged to do small pieces of research under guidance. The courses in plant and animal genetics are different, but all genetics students do some work with *Drosophila*, as well as cytology, biometry and phenogenetics.

As we only had a short time in the U.S.S.R. and did not visit many cities, the above account of work in progress is very incomplete (though it appears that a large percentage of the more important research is concentrated in Moscow and Leningrad). Thus I was unable to see anything of the work in agricultural genetics, notably the genetical research being carried on in the huge agricultural institution, the Timiriazev Academy near Moscow (where I understand much valuable work on polyploidy and on the genetics of cereals is in progress under Academician Jebrak); nor could I see that in the equally huge Forestry Research Institute near Leningrad, or the work on polyploidy in Breslavetz's department at the Botanical Garden of the University of Moscow. Karpechenko, the well-known plant geneticist, is unfortunately missing, presumed dead.

I had not the time to discover what had happened to the remarkable programme of work on the evolution and genetics of crop plants initiated by Vavilov (except that some of the seed-collections left at Leningrad were eaten during the siege). The abundant and valuable work in palæontology is being described by Prof. D. M. S. Watson and Dr. Edwards. Here I will only record the excitement of seeing a fossil Paleoniscoid fish larva from the Jurassic, with eyes and yolk-sac beautifully preserved.

In general, I may sum up my impressions as follows. In spite of the insistence during the last four years that Russian biologists, like other men of science in the U.S.S.R., should do some work of importance for the war effort, pure research seems to have been kept going to a somewhat greater extent than in Britain during the War (and, according to some of the American delegation, than in the United States.)

In some branches of Russian science, a certain spirit of scientific nationalism is to be observed. There is little of this, however, in general biology, apart from the efforts made in certain quarters to elevate Michurin from the position of an agricultural and horticultural empiricist to that of a great scientific pioneer and discoverer (there is even a town which has been re-christened Michurinsk, where much of Lysenko's work is now being carried on).

If in the U.S.S.R. no outstanding discoveries appear to have been made, no new principles established, in the field of general biology during the last few years (again I defer any discussion of Lysenko's work until later), yet the work has been of high quality, many-sided in its approach, and of great volume (though not so voluminous as, for example, in geology or agriculture).

In spite of the War, my Russian colleagues seem to have managed to obtain rather more knowledge of British and American results than we did of their work, though their supply of foreign and scientific books and especially journals is still very inadequate. They all showed the greatest courtesy and friendliness and were anxious to tell us of all they had been doing and thinking. They are hoping for a rapid improvement in the facilities for interchange of personnel, as well as of reprints, journals and books.

The U.S.S.R. is taking its place as one of the foremost countries in biological research, and I anticipate that they will soon be leading the world in some fields, notably in the relation between ecology, field study, taxonomy, genetics and evolution, where their vast continuous territory, with its extremes of environmental conditions, provides them with unrivalled opportunities.

CRYSTALLOGRAPHY

By Dr. W. A. WOOSTER
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ONE of the evil effects of the War has been the virtual isolation of scientific workers from their colleagues in foreign countries, and it was a particularly welcome invitation which the Russian Government extended to British crystallographers. During the War the laboratories in Moscow and Leningrad were largely evacuated to Kazan and other places in the east, and the resettling process is not yet complete. In spite of these difficulties, much fundamental and applied work has been carried on during the whole of the war period. The laboratories under the Academy of Sciences are well equipped with apparatus and have many trained scientific workers on their staffs.

The laboratory for morphological crystallography is in the Crystallographic Institute in Moscow. Part of the work of this laboratory consists in the routine examination of crystals derived from the numerous mineral deposits of the U.S.S.R. X-ray crystallography is carried on in at least four departments in Moscow. The substances studied in the Institute of Crystallography and in the Karpov Institute for Physical Chemistry are mostly minerals or inorganic substances. Among the former is included dioptase, the structure of which has recently been worked out, and among the latter, a number of cyanides, ferrocyanides and compounds containing other complex ions (Belov, Zdanov, Boky, Popova). Electron diffraction apparatus is being used for the study of crystals which occur in very thin flakes, for example, cadmium iodide and clay-forming minerals (Pinsker). Work, both theoretical and experimental, on certain inter-metallic phases and on the structure of thin metallic films is being carried on in the Physical Institute of the University under Prof. Konobievsky. The study of the influence of the state of chemical combination on the X-ray absorption edges and on the emission lines of certain elements is conducted by Prof. Borovsky in the Department of Petrology.

Crystal physics is much studied in the U.S.S.R. The school established more than twenty years ago by Academician A. Joffe has pursued its study of the properties of crystal and other solids with undiminished vigour. The work of Mrs. Joffe and other members of the Physical-Technical Institute in Leningrad, under the direction of Joffe, has shown the existence of new types of semi-conductors. A systematic survey of oxides and sulphides, particularly those of titanium (TiO_2), copper (Cu_2O), vanadium (V_2O_5), tungsten (WO_3), lead (PbS) and tantalum (Tl_2S), has shown that much more efficient rectifiers and photo-cells can be made with new combinations of metals and semi-conductors than can be obtained from the usual selenium-iron combination. The current per unit light intensity obtained with a tantalum sulphide – iron combination is twenty-five times greater than that given by the selenium – iron combination. Such photo-cells have now become sufficiently efficient to make it practicable to set up large batteries of them in desert places for the conversion of solar radiation into electrical energy.

It has also been shown that lead sulphide may give electronic or hole-conduction according as there is an excess or a defect of lead in the crystal structure, and that conductivities up to a thousand times that of the pure substance may be obtained with the material containing non-stoichiometric proportions of lead and sulphur. Work on these semi-conductors may have far-reaching effects on the manufacture of photo-cells and dry rectifiers.

Prof. Schubnikov (Institute of Crystallography, Moscow) has developed a new field by the study of piezo-electric textures. A cloth or wire gauze is stretched on a frame and molten Rochelle salt is brushed on, the direction of movement of the brush being always the same. In this way a plate looking rather like a plaster plate is built up in which the needle-shaped crystals of the salt are preferentially orientated in the direction of movement of the brush. Such a plate when coated with tinfoil or other electrodes forms a piezo-electric element suitable for the acoustic range of frequencies. Its internal damping is too high for it to be used in the supersonic range, but it can be used satisfactorily for microphones. Such plates may be made with the preferential orientation in one direction only or in two directions according to whether the plate is to be used for bending or twisting. These plates are strong and can be made of almost any size. Prof. Schubnikov has given the necessary extension of the theory of piezo-electricity to cover these preferentially orientated textures. Methods have also been found in the same laboratory of growing large single crystals of substances suitable for piezo-electric apparatus, for example, Rochelle salt, potassium dihydrogen phosphate and cane sugar. In relation to the latter crystal, it has been shown (Scheftal, 1941) that a change in the degree of supersaturation from 2·4 to 2·1 per cent makes all the difference between the development of a bad or a good crystal.

The mechanical properties of crystals have been studied intensively in the U.S.S.R. in recent years. A number of investigations by Miss Classen-Nekludova have demonstrated many of the fundamental facts concerning the plastic deformation and the rupture of rock-salt and certain metallic crystals. She has shown that rock-salt, when subjected to intense compression in one direction at a high temperature, twins according to a spinel law. Further studies on artificial corundum have shown how to determine the orientation of the crystallographic axes by optical means, what strains are present in the boules and how these strains influence the breakage of the specimens. A novel development in the study of the plastic properties of metals has been introduced by Stepanow (Physical Technical Institute, Leningrad), who uses fused silver chloride as a 'transparent metal'. The elastic and plastic properties of this substance have been shown to be of the same type as those of a metal. It shows a photo-elastic effect in polarized light, and this opens up possibilities of new studies on the plasticity of metals. A special plastic called 'Escapon' has been developed during the War, and it has excellent electrical and mechanical characteristics. It is made from butadiene rubber by compression at 20–50 atmospheres and between 16° C. and 200° C. according to the hardness required in the final product. A development which Joffe described as the 'vulcanization' of cellulose consists in acting on cellulose with certain quaternary ammonium bases to form oxygen bridges between the cellulose chains. Filter paper subjected to the action of these bases is rendered incapable of disintegration by water and it retains its strength even when immersed in hot water.

The following text-books in Russian have appeared recently: "The Elements of Crystallography", by A. V. Schubnikov, E. E. Flint and G. B. Boky (1940); "Elementary X-Ray Structure Analysis", by G. S. Zdanov (1940); "X-Ray Analysis of Metals", by G. S. Zdanov and Y. S. Umansky (1941); "Symmetry", by A. V. Schubnikov (1940); "Quartz and its Applications", by A. V. Schubnikov (1940); "New Apparatus for Crystal-Optical and Petrographic Investigations", by the staff of the Institute of Crystallography, Moscow (1940); "Crystals", by M. Shaskolskaya (1944); and "Analysis of Crystals by their Optical Properties, Part I", by G. B. Boky (1944).

In conclusion, it may justly be said that the study of the properties of crystals is in a very flourishing state in the U.S.S.R. at the present time, and it is to be hoped that the move towards co-operation so generously started by the Soviet Government will be reciprocated in the coming years.

PEDOLOGY

By Dr. ALEX MUIR

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THE development of pedology or soil science owes much to the initiative of Russian men of science, foremost among whom was V. V. Dokuchaiev, who laid the foundation of modern methods of soil classification. It is appropriate, therefore, that the principal centre of soil study in the U.S.S.R., the Dokuchaiev Soil Institute of the Academy of Sciences, founded twenty years ago, should bear his name. Many well-known figures in soil science have been associated with this Institute—Glinka, Gedroiz, Neustruev, Lebedev—and the British soil workers attending the recent Academy celebrations have had close contacts with the Institute since its foundation. We were given a great welcome on our arrival, and made honorary members of the staff for the duration of our stay so that we could come and go as we pleased. The present director, Academician L. I. Prasolov, and his staff had made careful preparations for the visit, and all the accounts of work in progress were fully illustrated with maps, diagrams and apparatus.

The activities of the Institute include research work on theoretical problems of soil science such as the genesis, geography and cartography of soils, soil systematics and classification, soil chemistry, physical chemistry, biochemistry and physics; but the practical side is not forgotten, and there are departments of agrochemistry and soil erosion, while saline soils and their utilization receive considerable attention.

Prasolov, who recently celebrated his seventieth birthday and forty years of scientific activity, is ably assisted by some 116 scientific and technical workers. A number of the senior members hold chairs in other institutions, which ensures close collaboration between the different organizations. In addition to this overlapping of staff, the Dokuchaiev Institute has a number of affiliated institutes in the various republics and some out-stations for the study of soils *in situ*.

Prasolov himself directs the work of the section on geography, cartography and classification, the activities of which are not confined merely to Russian soils. The Russians have long been interested in the application of their ideas of soil zonality to the rest of the world, and Prasolov has recently produced a new soil map of the world for inclusion in the Large Soviet Atlas. More detailed studies of the literature on the soils, vegetation, etc., of other regions have led to the production of new soil maps of Africa, South America and Australia. These maps and their accompanying memoirs, when they become generally available, should give a good picture of the extent to which the Russian conceptions of soil types can be applied to the more tropical countries.

For the U.S.S.R., one of the principal tasks of the cartography department is the preparation of a soil map of the Union on the scale of 1 : 1,000,000 which will be the standard map for the whole country. During the War, the surveys of the Institute were found of great use in the transfer of agriculture to the eastern regions, and considerable work is being done in the Urals, Kazakstan and Uzbekistan. While general soil surveys form an important part of the Institute's work, special surveys in connexion with erosion and salinization are also made and form the basis for the study of these phenomena and of methods of dealing with the practical aspects.

The weathering of rocks and minerals is the first stage in soil formation and is receiving considerable attention in the Institute. An interesting study is being made of the ash content of plants and the rock or soil on which they grow, and it has been shown that in the red Georgian soils there is a considerable movement of aluminium between the soil and certain plants in the natural vegetation; for example, hornbeam, beech and rhododendron. This fact has an obvious bearing on the relative movement of the soil constituents during development of the soil. In a study of rock weathering and soil formation under lichens, it is concluded that biological influence may be an important factor in the formation of clay minerals of the montmorillonite type.

The study of the nature and distribution of the clay minerals in soils has received close attention and a large body of data has been obtained. In addition to the usual X-ray and thermal methods of examination, use is being made of an electron diffraction method with some success. Other laboratory studies include exchange reactions, the nature of soil acidity, soil solution by high-pressure extraction and the nature of soil aggregates. The study of aggregates is made from the physico-chemical aspect with the view of elucidating their structure and origin in the various soil types, and also from the purely physical aspect to obtain a measure of their resistance to the destructive influences of erosion. The first aspect is an elaborate study involving microscopic examination of the aggregate at the different stages of the chemical treatment. The interesting result of the case of chernozem aggregates is that the clay minerals seem to be wrapped round the organic matter, resulting in a very stable aggregate.

Of the out-stations set up for the study of soils *in situ*, the best equipped, namely, those in the podzol and chernozem zones, suffered greatly during the War and work on them has had to be begun afresh. Some valuable results had, however, been obtained. It has been found that there is a seasonal shifting of the carbonate horizon of the chernozem up and down in the soil, the range of movement depending on meteorological conditions, but in one year reaching as much as 17 cm. This seasonal migration of carbonates impedes the loss of calcium from the rooting zone and so results in the chernozem being an extremely stable type.

While this account of the work going on in the Dokuchaiev Institute is necessarily brief, mention must be made of the soil museum which is still housed in Leningrad. It is one of the most complete collections of Russian soils and forms a valuable guide to the soil geography of the country. Since soil excursions were not possible during our visit, it was a most useful refresher to be conducted round the museum by its curator, Miss Shokalskaya, and have its contents explained by her in excellent English.

Recent articles in *Nature* have referred to the very fine geochemical studies being carried out in the U.S.S.R., and since these have an obvious bearing on certain soil problems, we were glad to have the opportunity of visiting the Vernadsky Laboratory of Geochemical Problems of the Academy. In this institute, under A. P. Vinogradov, there is going on a great amount of work on the distribution of the minor elements in soils and biological materials. The laboratories are very well equipped with modern physical apparatus, including X-ray spectrographs and recording photometers. One of the principal tasks of the institute is the construction of a map showing the geochemical provinces of the U.S.S.R., and considerable attention is being paid to the relation of endemic diseases and minor element distribution.

(*To be continued.*)

THE INFERIORITY COMPLEX AND THE PARANOID TENDENCY: WITH A BRIEF REFERENCE TO NAZI PSYCHOLOGY[*]

By DR. WILLIAM BROWN
University of Oxford

THE subject-matter of this essay has a very important bearing upon the world problems of the present day. The popular conception of the inferiority complex has become a scandal in modern psychology. It is a term easy to use, and it has suffered a fate somewhat similar to that of the word 'idea' in John Locke's "Essay Concerning Human Understanding" (1690). In that work he used the term 'idea' in a special sense, as illustrated in his definition ("Essay", Bk. I, Chap. i, § 8): "whatsoever is the object of the understanding when a man thinks". The general line of his argument was "the new way of ideas", of which Stillingfleet spoke—disapprovingly—on the first appearance of the "Essay". But Locke himself used the word in several different ways, and very soon it got into the general vocabulary of English literature in a large number of senses. That is an aftermath of Locke's important work.

Misuse of the Term 'Inferiority Complex'

It seems fated that the term 'inferiority complex', which had a fairly definite meaning when originally developed by the late Dr. Alfred Adler and some of his followers, should come into general use in so vague a form as to be of practically no value for the man of science. It is misleading because it gives an air of profundity to statements which are extremely elementary and superficial. Here I am not criticizing Adler's general position in the succession of the great medical psychologists, Sigmund Freud and C. G. Jung. We have much to learn from all three of them. Each has a message and to each belongs much solid research work on the mind. But it is a little unfortunate that Adler's position in psychology should be so much easier to understand at first blush than the systems of Freud and Jung. The result has been that it has attracted popular thought and opinion because of its simplicity, and has discouraged deeper consideration of these problems by the general educated public.

I am not at all sure that it was Alfred Adler himself who first used the term 'inferiority complex'. He spoke first of 'organ-inferiority' (*Minderwertigkeit von Organen*), a physical deficiency to which individuals react physiologically and psychologically in different compensatory ways. Adler's book on "The Neurotic Constitution"[†] contains much fundamental discussion along this line of thought. But when he came to deal more closely with the mind and its reactions, someone or other—I do not know who—introduced the term 'complex' in popularizing his psychological point of view: a word much used in those days, starting with Freud's 'Œdipus complex', and Jung's use of the term as meaning a repressed system of ideas with an emotional colouring, revealing itself in consciousness in a *disguised* form. So the word became attached to inferiority—*Minderwertigkeit*. This 'feeling of inferiority', *Minderwertigkeitsgefühl*, which in some respects we all share in one direction or another, undergoes (through repression) transformation in various ways to become an 'inferiority complex'—in other words, the total mind reacts to the feeling of inferiority, with all manner of results in thinking, feeling and behaviour.

Every one of us is, of course, inferior in some direction or other. No one can do everything well. A man may be a genius in some directions, but a dunce in others. We have to accept our limitations, recognize them for what they are, realize that nothing can be done about it, and push on with those lines of activity in which we are outstanding, or relatively normal and efficient. If we attach an excessive value to certain abilities and powers, artistic or intellectual or whatever they may be, which we ourselves do not possess to any great extent, but wish we did, we may come to imagine ourselves possessing them in a greater degree than we do, so that a certain distortion appears in our mental outlook. We are no longer single-minded, honest-to-goodness people moving forward with all the forces at our disposal; we begin to pretend to be something which we are not, and we deceive ourselves, and perhaps—which is less likely—deceive others. Man is the only animal capable of deceiving himself, and that self-deception accounts for many of the troubles of the world. We do not like to admit our inferiority even to ourselves, and in hiding it, we develop an inferiority complex. We pass from a '*feeling* of inferiority', which is straightforward and unblamable, to develop an '*inferiority complex*', a reaction which is not straightforward, which is a sin against our own nature, by pretending to be what we are not, and putting up a mere façade in the sight of the world.

Compensation and Over-compensation

In trying to hide our inferiority from ourselves we may over-compensate. There is an automatic tendency in any organism to compensate for deficiency, but it is easy to compensate to excess. A familiar example is the youth who is by nature diffident, retreating, and shy; and who, as a result of over-compensation, develops a blustering and swaggering attitude. Again, many people compensate for lack of success by imagining it, and as they give way to their phantasies and day-dreams, they come at last to believe that they have the power or to pretend that they have it, while at the same time retreating from any actual test.

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[*] Based on a lecture delivered at Christ Church, Oxford, on November 25, 1944.

[†] Translation by B. Glueck and J. E. Lind (New York: Moffat, Yard and Co., 1917).

An alternative reaction is just to fall ill, when confronted with a real test. The person concerned may suffer with headache, anxiety, depression, sleeplessness, loss of appetite—general symptoms which cannot in his case be explained in terms of physical disease, but are quickly understood by one who knows the real situation. There are these various possible reactions to the feeling of inferiority, and they are evidence of the existence of the complex—a complex involving self-deception, which nevertheless is not quite complete. The term should be used only to describe *a distorted conscious reaction in the mind of the individual to a repressed or rejected feeling of inferiority*.

The general public, including some journalists, in seizing upon this term, have used it almost invariably in the wrong sense. They talk of 'inferiority complex' when what they have in mind is simply the fully conscious awareness by an individual of his inferiority in some direction or other—a very different thing. But although the inferiority complex is a further stage of complication in the mind, a stage beyond the clear consciousness of inadequacy, a disguise, a mask, a distortion, a camouflage, it is a very superficial form of disguise. The inferiority complex—using the term in its exact sense—is not very important and is easily dealt with. Those, for example, who wish to become psychotherapists, and get themselves analysed in order, so to speak, to have a mental cleansing before starting work, get rid of their inferiority complexes fairly quickly in the course of their analysis. The inferiority complex is at a relatively superficial level of the mind, and the more unconscious levels have yet to be reached.

Deeper Analysis

I found it not surprising, when in 1926 I came to know Alfred Adler personally, that he did not consider it necessary to carry out really deep and prolonged analyses, even in special cases. I think that that attitude was unfortunate for the Adlerian development of psychology. Adler stated that he could generally sum up his patient in one or two interviews—an insult, really, to human nature to suggest that it can be so casually explored. To go deeper one must have recourse to Sigmund Freud's analytical method and general explanatory system (whatever one may think of his central theory), with its conception of *libido*, sexual energy in its widest sense, which supports and sustains the world, the Ἔρως of Greek philosophy and myth, rooted in the physical, and yet transcending this in æsthetic and spiritual insight and inspiration.

Directly the *libido* is brought in, we reach a much deeper level of the mind. The *libido* is relatively impersonal, as contrasted with the organized ego ; it is the *Id* (*das Es*), it is something below and beyond the individual and for the most part unconscious. The individual, as Jung said, is rather like a frail craft floating on the turbulent waters of the unconscious. Jung took the *libido* in a wider sense than that of Freud, as meaning instinctive energy in general, somewhat, though not exactly, like the *élan vital* of Bergson's philosophy. Using the conception in the narrower, Freudian sense, we find reactions of a complex nature, where love may be linked up at a primitive level with aggressiveness or destructiveness, with *sadism* as a result. Later, mental reactions to this sadism may produce an obsessed type of personality. At the level of the inferiority complex there is just wounded self-love, self-centredness. Self-love or narcissism, according to the Freudian theory, is a fixation of *libido* upon oneself. But it should be projected upon others and should result in the linking up of individuals in the group, sustaining the loyalty of the individuals of the group to a leader, where a leader is involved, and making the individuals "members one of another", to use the Pauline phrase.

This love or *libido* in its original form is both homosexual and heterosexual. It can be felt for individuals of the same as well as for those of the opposite sex. Freud held that there is a homosexual constituent of the *libido* in everyone, which normally becomes sublimated before and at adolescence. It emerges in feelings of friendship, good-fellowship and group loyalty. It is expressed in that beautiful lament of David for Jonathan (Samuel II, Ch. i, §§ 17–27), and in Shelley's "Adonais", his elegy on the death of Keats. On the heterosexual side, however, love or Eros is more deeply held, because here it has a physical function to serve, that of handing on the torch of life to the next generation, but it too becomes spiritualized in its higher forms. There is such a thing as "a love passing the love of women", and, higher still, that *Amor intellectualis Dei* which Spinoza took as the goal and guiding star of his system of philosophy.

The Paranoid Tendency

This leads me to the consideration of a mental tendency which in my research work in medical psychology I am learning to regard as of great importance, namely, the paranoid tendency. It is rooted in unconscious mental activity, at a deeper level than that supporting an inferiority complex, in relation to the development of the super-ego (the primitive psychological basis of conscience) by the processes of introjection and projection. This deeper root is its relation to the *libido*, mainly though not exclusively to the homosexual element in it. I am not yet sure to what extent the paranoid tendency may be linked up with heterosexual *libido* ; it may be not infrequently so. But in full-blown paranoia, where the paranoid tendency appears in, as it were, pure culture, repressed homosexuality seems to be invariably present and the main cause of the delusional system (*Wahnsystem*).

This condition of paranoia, which has a hereditary basis, is not so rare a mental illness as the few cases seen in mental hospitals would suggest. It is more a general type of character and personality than a special mental disease or psychosis, with *fanaticism* as an outstanding characteristic. The paranoiac is born rather than made, and if his family history be inquired into there will generally be found some evidence of the same tendency in previous generations, showing itself sporadically in the family tree. The trouble about the paranoiac is that he is detected and dealt with only when he becomes an evident danger to himself and to others. It is then that he is placed in a mental hospital. But few paranoiacs are found in mental hospitals—the broken-down failures in this line of personality ! The majority of them escape general notice and detection and are out in the world, causing a great deal of family and social disturbance. I venture to say that they are a greater danger to world peace than any other type of mental abnormality. The earlier they are tracked down the better.

But the 'paranoid tendency', which is not identical with paranoia, is still more widespread, and may appear in everyone at some time or other, manifesting itself unmistakably under some particular mental stimulus or provocation. I mean by the paranoid tendency a general disposition to misjudge people, to become suspicious without adequate grounds, to feel that people are working against one when they are not really doing so. The main psychological mechanism involved is that of projection—a projection of the person's aggressiveness and hostility upon others. The tendency is to be explained by the fact that the individual does not fully understand himself and has inadequate control of his excessive aggressiveness.

A person suffering from paranoia, as distinct from the more general paranoid tendency, is usually of a very aggressive temperament, and because of that, his *libido* has a very rough passage in his mental development. Usually he does not 'get on with' the other sex. The homosexual constituent in his *libido* is more pronounced than the heterosexual. His aggressiveness also is linked up with feelings towards his own sex, with homosexual tendencies which have been repressed instead of being adequately sublimated. The homosexuality is not admitted by the person concerned; it is rejected and denied. Under repression, the love is actually turned to hate in the unconscious. This hate is then 'projected' upon the other person. He believes that this other person hates him and therefore persecutes him. The person whom he was ready to love but would not allow himself to love becomes in imagination his persecutor.

Thus the development of persecution mania begins. It is one stage in the development of the average paranoiac. But he may go further and for two alternative reasons develop megalomania. The ordinary explanation of the development of megalomania is that the individual supposes himself persecuted and then asks himself, "Why are all these people against me?" He comes to the conclusion that he must be a very important person if all these others find it necessary to combine against him in this way. He may go so far in his vision of himself as to consider that he is a kind of Messiah, with a special mission.

The other alternative is Freud's explanation, that the *libido* in such a case is withdrawn altogether from the outer world, and fixed upon the self or ego, thus narcissistically inflating the ego, and producing a regression to infantile narcissism. Megalomania, in Freud's view, is of an infantile nature, and represents a regression or step back from sublimated homosexuality to the infantile stage of narcissism, or fixation of *libido* upon the ego*.

Thus we have the two fundamental characteristics of full-blown paranoia: persecution mania (*Verfolgungswahn*), and megalomania (*Grössenwahn*). Paranoia is well defined in Kraepelin's words as "the insidious development, following from inner causes, of a lasting unshakable delusional system (*Wahnsystem*), which proceeds with complete preservation of clearness in thinking, willing and acting".

But the paranoid tendency is of much wider incidence, revealing itself in relatively normal individuals in special mental situations, with wrongful imputing of motives and misunderstanding of intentions, so that such people are unnecessarily suspicious and 'on the defensive', taking offence where none is intended and "fleeing where none pursueth". The tendency is linked up with aggressiveness and possibly with the (incompletely sublimated) homosexual constituent of the *libido*, and with a distorted development of the super-ego through the processes of introjection and projection which occur in the young child's mind in relation to parents, nurses, etc.

The Situation in Germany

This discussion has an important bearing on the psychological situation in Germany to-day. Many people are content to sum up the problem from the psychological side by saying simply and baldly, "Germany has an inferiority complex", "Hitler had an inferiority complex". No doubt both leader and nation had inferiority complexes in full measure, but these superficial distortions of their minds are not adequate to explain their outrageous behaviour in the last few years. It is something deeper than an inferiority complex which is concerned in the German problem, namely, a paranoid tendency. I have always said that Hitler was a paranoid personality. He was already suffering from some degree of persecution mania and megalomania in the days of his rise to power. The state of his mind was very characteristically shown in his reactions to the Jewish problem in Vienna, as described in Chapter 2 of "Mein Kampf". Hitler's reactions to Jewry and to Bolshevism were paranoid reactions. The line he took, that "terror must be met by terror", is the attitude of the paranoid personality. He was always in a state of defence, arming himself against what must have been at first an imaginary situation, however real it may have become later on owing to his own acts.

No one can be paranoid who fully understands himself. Hitler did not understand himself. To himself he was a knight in shining armour; and the people of Germany, after long-continued disappointment and frustration, came to accept him at his own valuation, especially when he received the support of the military and of 'big business'. The nation had lost its way, and here it found someone who seemed to believe in himself, and accordingly it came to believe in him. The paranoid person, on the surface, does believe in himself; so, for that matter, does the real Messiah, but Hitler was a false and not a real Messiah*.

The people rallied to him, step by step—I need not go into the history of the rise of National Socialism in Germany. He collected around him a number of paranoid individuals, or at any rate psychopathic personalities. The Nazi leaders seem all to be, or to have been, more or less abnormal.

Spread of the Paranoid Tendency

The psychological consequences of all this in the development of the German nation are clear. The people had become desperate and had lost their way. They were encouraged to be aggressive because they were told, and believed, that they were encircled again, and that others wanted to wipe them out. That was the very simple propaganda repeated by Goebbels on every occasion. "This war which was forced upon us. . . ." Goebbels revealed himself most clearly as a classic example of 'acquired paranoia'

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* Sigmund Freud, "Collected Papers", 3, 449–452 (Hogarth Press, 1925).

* Hitler was also hysterical, and suffered from hysterical blindness at the end of the War of 1914–18 (see "Mein Kampf", p. 223 in the German edition).

(if one may coin such a phrase) in some of his weekly articles in the Nazi publication, *Das Reich*. In the literal sense, of course, paranoia cannot be acquired; it is inborn in the individual, but it can take a collective form which is acquired in the group. It has been pointed out by psychologists that as soon as a group is formed the paranoid tendency may spring up as a collective characteristic*. It seems to be a fundamental tendency in group psychology. One group may become paranoid in relation to another. Groups of all kinds link up or develop hostilities towards one another; and if their members are put into uniform the paranoid tendency is magnified.

Germany is going to be one of the great political and psychological problems of the next generation. It is a problem which will require to be dealt with in a strictly scientific way, by the accumulation of facts, not of phantasies or rumours, and the arrangement of such facts in relation to possible hypotheses, which must be tested and confirmed. To this problem some Germans themselves will make valuable contributions. It will be a problem for us all for a generation, for it cannot be left unsolved. We cannot leave a political vacuum in the middle of Europe.

The above essay was written before the cessation of hostilities. But now that Germany and Japan have been completely defeated and the atomic bomb has been invented and used, national mentality and the group mind are in need of understanding and control as never before. It is easier for an atom bomb to wipe out a city than a mental complex. The sciences of psychology, sociology and politics must not fall too far behind the physical sciences in their future development, if ultimate disaster is to be avoided.

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* H. Schulte: "Versuch einer Theorie der paranoischen Eigenbeziehung und Wahnbildung", *Psych. Forsch.*, 5 (1924).

NEWS and VIEWS

New Sibthorpian Professor at Oxford: Mr. G. E. Blackman

MR. GEOFFREY BLACKMAN, son of Prof. V. H. Blackman, goes to Oxford next term as Sibthorpian professor of rural economy. He succeeds Prof. J. A. Scott Watson, who last year joined the Ministry of Agriculture as chief education and advisory officer. Mr. Blackman was educated at King's College School, and at Cambridge (St. John's) where he took both parts of the Natural Sciences Tripos. After a year of postgraduate work in the Soil Physics Department at Rothamsted, he took up, in 1927, the headship of the Botany Section of the Jealott's Hill Research Station, Berkshire, then newly established by Imperial Chemical Industries, Ltd. In one sense his researches during his eight years tenure of the post were directed to practical ends, such as the improvement of pasture by various combinations of fertilizer and grazing treatments, and the use of various chemicals in the control of weeds. But he contributed materially to the application of modern statistical methods to the botanical analysis of pastures and, what was more important from the long-term point of view, played his part, along with the Aberystwyth workers and others, in developing the ecological approach to grassland problems and to those of weed-crop competition.

Since 1935, Mr. Blackman has been lecturer in plant ecology at the Imperial College, London. He was also, for three years before the War, assistant science editor of the *Gardeners' Chronicle* and, since 1942, has been honorary secretary of Biology War Committee. Also, since 1941, he has headed a team of workers, under the Agricultural Research Council, who have been engaged on two major projects. One is the introduction from overseas of improved varieties of oil seeds (sunflower, soya bean and linseed) and maize. This work is still in progress, but has already shown that certain North American linseeds are greatly superior to the mixed La Plata type previously grown; that sunflower seed of good quality can be produced in Britain; and that certain of the new hybrid types of maize, from the northern United States and Canada, have great promise as forage crops, and especially as silage crops, in southern England. The other project has been a continuation of the long search for more effective and more highly selective herbicides. The practical results already achieved are very important. For example, sulphuric acid, in appropriate concentration, has almost eliminated the laborious process of weeding onion crops; copper nitrate, copper chloride and the sodium salt of di-nitro-*ortho*-cresol can be safely and effectively used on flax. Sulphuric acid, applied before the emergence of crop seedlings, is of great value in the case of crops such as carrots and beet which, on account of their slow initial growth, are specially liable to be smothered by quick-growing annuals. But most remarkable has been the discovery that certain plant-growth substances, applied at rates of the order of a pound per acre, completely destroy certain species and leave others quite unharmed. One of these materials (C.L.C.), which will soon be available in quantity, is very strongly toxic to a large number of dicotyledonous plants, and harmless to cereals and most other monocotyledons. It is to be hoped that Mr. Blackman will find at Oxford time and facilities to continue this extremely profitable line of work.

Advisory Committee on Atomic Energy

IN reply to several questions asked in the House of Commons, the Prime Minister has stated that many questions involved in the future of atomic energy, including that of the international handling of the subject and its possible development for industrial purposes, are engaging the attention of the Government. To assist the Government in dealing with the far-reaching questions raised by the discovery, both as regards its international treatment and its further development in Britain, whether for industrial or military purposes, the Government has appointed the following advisory committee: Sir John Anderson (chairman), Sir Alexander Cadogan, Permanent Under-Secretary of State, Foreign Office; Field-Marshal Sir Alan Brooke, chief of the Imperial General Staff; Sir Alan Barlow, Second Secretary of the Treasury; Sir Edward Appleton, secretary of the Department of Scientific and Industrial Research; Sir Henry Dale, president of the Royal Society; Prof. P. M. S. Blackett, Langworthy professor of physics in the University of Birmingham; Sir James Chadwick, professor of physics in the University of Liverpool; and Sir George Thomson, professor of physics at the Imperial College of Science and Technology, London. In response to further questions as to the precise functions of this committee, Mr. Attlee stated that it will advise the Government both with regard to the scientific progress and the general background of the whole subject, but that the Government itself will decide questions of policy arising out of the discovery.

The True Foundations of Peace

THE recently published draft proposals for an Educational and Cultural Organization of the United Nations (London: H.M. Stationery Office. *2d.* net) have received the welcome due to a document answering to one of the first needs of the hour. Ever since 1942, discussions among Ministers of Education or their equivalent in the United Nations have taken place, and the organization now proposed has developed therefrom. In these discussions, Mr. R. A. Butler took an active part from the first. The draft proposals will form the basis of discussion at a conference to be opened in London on November 1. That conference will be one of the first results of the San Francisco deliberations, and the organization in question will be the first "specialized agency" to come into being under the relevant clause of the United Nations Charter.

The cardinal aim of the organization is "to develop and maintain mutual understanding and appreciation of the life and culture, the arts, the humanities and the sciences of the peoples of the world". This truly magnificent aim the organization will seek to further by various means. It will facilitate consultation among leaders in educational and cultural life, assist the free flow of ideas and information through every established medium with special attention to the exchange of information on educational and cultural developments, including advances in scientific knowledge, foster the growth in each country of measures to give support to international peace and security, conduct and encourage research into the problems related to the maintenance of peace and advancement of welfare, and assist countries that need and request help in developing their educational and cultural activities. The organization will operate through a conference, an executive board, and a secretariat. It is intended that the conference shall meet at least once a year and that all activities related to the functions of the organization shall be reported periodically. It is to be hoped that the conference to be opened in London on November 1 will be the beginning of great things in the cause of human progress and welfare.

Books and Journals for Holland and Denmark

INFORMATION regarding the conditions of life in scientific departments is beginning to come from Central Europe. After privations of various kinds Prof. O. Winge, Dr. Westergaard, Dr. A. Skovsted and Dr. C. A. Jorgensen in Denmark have now returned to their posts. One of their greatest difficulties is that they have been cut off from all knowledge of science in the rest of the world, and they are in great need of scientific journals, reprints and similar information. The conditions in Holland and France are even worse, since in many cases the Germans removed anything of scientific value that they could lay their hands on. It is possible to send letterpress to Sweden, Denmark, France and Holland through the Censor in Charge, Postal and Telegraph Censorship Dept. Permit Branch, Aintree, Liverpool, if these are marked "Paragraph 42" and the weight does not exceed 1 oz. for Holland and Denmark, or 4 lb. for Sweden and France. Dr. F. W. Sansome, Botanical Department, University, Manchester, 13, to whom we are indebted for the above information, states that he would be glad to aid in the transmission of such parcels if any difficulty is met with in transmission through the normal channels.

Nietzsche and Science

MARIO BUNGE (*Revista Continental de Filosofia*, 2, No. 4, Nov.–Dec. 1944) has written a useful perspective of Nietzsche's attitude towards science. Nietzsche's main ideas are both anti-scientific and anti-rational, and his own confession, "I know very little about the results of science", was quite unnecessary, as is obvious from the puerility of his views on different sciences. Apart from his great influence on contemporary thought—which is not always recognized—he was a typical product of the decadence of European culture, and in general of the decadence of the philosophy which originated with positivism and culminated in the modern anti-intellectualism. Hence, Bunge says, we may say that Nietzsche is not only the direct forerunner, but also to a large extent the characteristic exponent, of so-called modern philosophy. He attempted to destroy standards of values and to create others, and he made no secret of the fact that those he wished to destroy were cultural—the scientific, philosophical, ethical, æsthetic, religious, etc., and above all, the social and political values which were an obstruction to the *junker* class. His attitude towards cultural interests is seen in his reply to the question, "What is science ?", and the whole epistemology of Nietzsche is summed up in this reply: "It is the experience of men for their instincts and the instinct to know their instincts." The *summum bonum* is the instinctive life, not just an animal existence, but the free manifestation of the desire for domination ; not the longing for quiet joy, but the peril of action, the struggle, and through this the ascendancy. Nietzsche had no desire for science but for knowledge ; though not knowledge of the contemplative kind, but a knowledge active and authoritative. His ideas do not constitute so much a system of philosophy as a vague and obscure vision of the world, more suitable to a demoniac than to a philosopher seeking truth. In short, one might say that his attitude to science is, generally speaking, negative ; and when it is not that, it is something much worse—a restrained pretence but brutal and also pragmatic in the worst sense, namely, that of the prostitution of science as a priestess of Moloch.

British Universities

IN *Britain To-Day* of May 1945 (No. 109), Sir Charles Grant Robertson, in an article entitled "The Idea of a University", analyses some of the characteristics of British universities as a whole. He discusses their claim to contribute an interpretation of life, built up through centuries of effort and travail, which has enabled them to survive grim ordeals and emerge stronger and purified by the struggle and which embodies the fundamentals of any civilization worth the name. First, Oxford and Cambridge and, through them, the modern universities represent in an unbroken tradition and growth the medieval ideal. Secondly, no British university has been created, endowed or maintained by the State, and until 1920 the State did not contribute either to capital or to income expenditure. Thirdly, British universities are now co-educational, and the one imperative condition imposed on them is that unqualified persons should not be let loose on the community. Fourthly, the universities, if not the sole, are the main avenues to the professions and to all branches of teaching. They are second to none in the range and quality of their studies, equipment and teaching, and the demand for strengthening every form of research comes primarily from the universities, because their staffs know what can and ought to be done, and enlighten the community by doing it. Finally, after emphasizing that the freedom and independence of British universities are a sure guarantee of their capacity to meet the needs of the future, Sir Charles insists that, in accordance with the medieval ideal, a university is not a real university unless its members pray together, work together and play together.

New Film-Strip Projector

In the field of education, the post-war period is likely to be characterized by a marked increase in the use of visual aids. The ordinary lantern will most probably be replaced, except for large audiences, by the film-strip projector. The advantages of this newer form of projector are many and do not require elaboration. Further, it is likely that the film-strip projector will be used for educational purposes in conjunction with a sub-standard cinematograph projector; for, to-day, the complete visual unit comprises a film together with film-strips, charts, etc. Although a few associations have concerned themselves with visual education during recent years, progress has not been possible because of the lack of projectors for films and film-strips. To-day, the outlook is brighter, and Messrs. Dufay-Chromex, Ltd., 14 Cockspur Street, London, S.W.1, announce that they will have a new film-strip projector on the market in the near future. It is of attractive design and incorporates many new ideas which have been developed while the machine has been in use with various Service Departments. Several features are worthy of special mention. The gate is modelled on that of a cinematograph projector, and traction of the strip is effected by a lever which, with a single movement, advances the strip one frame. The gate is adaptable for three sizes of frame which are in common use. The optical unit merely slides in the lamp house, thus permitting the easy replacement of a projection lamp. The film is kept flat in the gate by a glass plate, the pressure on which is removed as the film is passed through.

Earthquakes During the First Quarter of 1945

During the first quarter of 1945, fourteen earthquakes were registered by the seismographs at King's College Observatory, Aberdeen, and Dr. A. E. M. Geddes reports that the instruments were not working during March 7–21. The largest shock was on February 10, registered at Aberdeen at 05h. 9m. 48s. G.M.T. from an epicentre estimated distant 77·4°, and developed a maximum ground amplitude on the east component at Aberdeen of 178 μ at 05h. 36m. 11s. G.M.T. At the Dominion Observatory at Wellington, New Zealand, six strong earthquakes were registered during February and five during March. The earthquake on February 26, with epicentre about 77° from Wellington, was a deep-focus shock, the focus being 180–200 km. below the surface of the earth. The earthquake of March 18 had its epicentre south o the Kermedecs, only about 7 km. distant from Auckland, New Zealand. The greatest felt earthquake in New Zealand during February occurred on the 18th and was felt in north-west Nelson with intensity on the modified Mercalli scale of 4. During March fifteen earthquakes were felt in New Zealand, the greatest intensity being scale 4 at New Plymouth on March 11, in the northern part of South Island and the Cook Strait region on March 12, at Wairoaton on March 19 and at Masterton on March 19 (separate shock).

During March, twelve earthquakes and tremors were registered by the seismographs at the geophysical observatory at Toledo, Spain. The strongest of these was on March 18; *iPz* registered at 00h. 09m. 33s G.M.T. from an epicentre some 76° distant, and a ground amplitude of 35 μ was attained at Toledo at 00h. 33m. 21s. G.M.T. The United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has determined the provisional epicentre of the earthquake of March 17, using reports from ten seismographic observatories, to be at lat. 6·9° N., long. 78·0° W., which is off Colombia.

Announcements

The centenary celebrations of the Imperial College of Science and Technology, London, will take place during October 25–27. The opening meeting will be held in the Albert Hall, and will be attended by the King, as visitor of the College, who will be accompanied by the Queen.

The fifth series of postgraduate lectures arranged by the London Section of the Oil and Colour Chemists' Association will be delivered by Prof. E. N. da C. Andrade, who will speak on "Viscosity and Plasticity". The lectures will be given at the Royal Institution, Albemarle Street, London, on October 11, 18 and 25, at 6.30 p.m. Admission will be by ticket only (price 10*s*.), applications for which must be sent to David E. Roe, c/o Atlas Preservative Co., Ltd., Fraser Road, Erith, Kent.

The following appointments in the Colonial Services have been made: J. McA. Todd, to be plant pathologist, Gold Coast; R. E. T. Hobbs, agricultural officer, Kenya, to be senior agricultural officer, Kenya; A. C. Maher, agricultural officer, Kenya, to be senior soil conservation officer, Kenya; O. S. Swainson, principal agricultural officer, Nigeria, to be senior agricultural officer, Zanzibar; T. Y. Watson, agricultural officer, Kenya, to be senior agricultural officer, Kenya; I. R. Dale, assistant conservator of forests, Uganda, to be senior assistant conservator of forests, Uganda; A. Foggie, assistant conservator of forests, Nigeria, to be senior assistant conservator of forests, Nigeria; J. C. Rammell, senior assistant conservator of forests, Kenya, to be conservator of forests, Kenya.

The Museum Book Store, Ltd., 45, Museum Street, London, W.C.1, state that they have acquired the library of the late Prof. Hans Sachs (see *Nature*, May 19). The collection includes long runs of the *Centralblatt für Bacteriologie*, *Zeitschrift für Immunologie*, etc., and some ten thousand reprints in 119 labelled boxes. Particulars will be sent on request.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

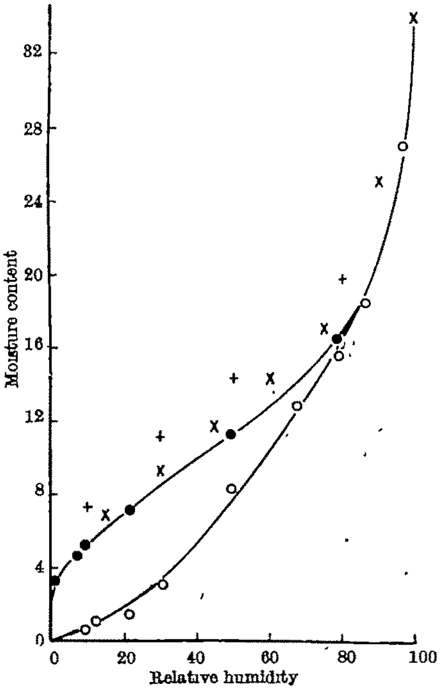
Hysteresis in the Adsorption of Water Vapour by Wheat

The water-vapour adsorption isotherm for wheat has been measured by several workers[1,2,3]. These measurements have been made under similar conditions; the wheat, which was initially at a moisture content corresponding to average storage conditions (~ 13·5 per cent of dry weight), was exposed to a series of atmospheres maintained at definite relative humidities. The equilibrium was attained in all measurements from a relatively high moisture content, and no attempt was made to study the phenomenon at extremely low relative humidities. In particular, no distinction was made between adsorption and desorption, so that it was not clear whether hysteresis was present or not.

Fairbrother[4] has reported that dried wheat flour does not completely regain its moisture content when re-exposed to the original relative humidity. He also found that wet and dry wheat, when mixed, do not reach equal moisture contents, that of the dry wheat always remaining about 2 per cent below that of the wet. Pap[5] and Ankers, Geddes and Bailey[6] have substantiated these observations. It appears from this that hysteresis is present in the adsorption of water vapour by wheat, and Fairbrother has suggested it as an explanation of his observations.

In the course of some work in this laboratory, we have measured the equilibrium moisture content for some No. 1 Garnet wheat at various relative humidities for both increasing and decreasing relative humidities; a very definite hysteresis has been found. This is shown in the accompanying graph, where for comparison purposes the results of Coleman and Fellows[1] and those of Gane[2] have been reproduced. The measurements in this work were made by means of a McBain sorption balance, and all moisture changes were carried out in an atmosphere of water vapour, the air being completely exhausted from the apparatus. The relative humidities were maintained by means of saturated solutions and were measured with a vacuum oil manometer. The temperature of the measurements was 24·5° C.

The slope of an adsorption isotherm at any point gives the change of moisture content per unit change in relative humidity. This quantity is analogous to the specific heat in the corresponding relation between heat content and temperature, and Daynes[7], in considering adsorption by rubber, has called it the 'specific solubility' and designated it by the symbol S_h. Daynes[8] has pointed out that with an adsorption isotherm such as that of rubber, which is convex towards the humidity axis, S_h increases rapidly as the moisture content increases, and the approach to equilibrium at high humidities is a very slow process. On the other hand, in drying, S_h becomes progressively smaller as the humidity is reduced, and desorption proceeds rapidly and quickly approaches an end-point. The reverse of this effect has been observed with leather, which has been found to take up moisture quickly and to be very slow in drying[9]. On Daynes' reasoning this is the result of the fact that the isotherm for leather is concave to the humidity axis.



○, adsorption; ●, desorption; ×, Coleman and Fellows' average for hard red winter wheat at 25° C.; +, Gane, weak wheat at 20° C.

When hysteresis is present, the 'specific solubility' will not be the same for adsorption and desorption. With an isotherm such as that shown, the adsorption curve is convex to the humidity axis throughout, while the lower part of the desorption branch is concave. We should therefore expect a progressively slow up-take of moisture such as is found with rubber and, equally, a slow drying corresponding to that observed with leather. In point of fact, moisture changes do take place slowly with wheat, but it is with the drying of wheat at low humidities where the effect is most noticeable. It is a long and difficult process to extract the last few per cent of water from wheat by means of a desiccating agent or a vacuum; if the wheat is to be dried within a reasonable time, it is necessary to use a vacuum oven-drying method. The shape of the isotherm offers an explanation of these facts, for at low humidities the desorption branch becomes very steep and it would be necessary to extract a relatively large amount of moisture with a very small pressure difference. On the other hand, the adsorption curve is very flat at low humidities and in that region wheat will adsorb moisture very rapidly; it is only at high humidities that the adsorption process becomes slow.

It should be pointed out that the high 'specific solubility' is not necessarily the only factor which tends to make the drying of wheat at low moisture contents so difficult; it is probable that the coefficient of diffusion of water vapour through the wheat decreases very rapidly at low humidities. King[10] has shown that the diffusion constant for keratin becomes extremely small at moisture contents below 6 per cent, and Glückauf[11] has pointed out a similar effect with a hair hydrometer. For these substances then, moisture changes at low relative humidities would take place at a slow rate owing to the small value of the coefficient of diffusion, and it is exceedingly probable that a similar effect exists in wheat. The change in the 'specific solubility', however, exerts a differential effect since it is just at the extremely low vapour pressure, where the adsorption branch is very flat, that the desorption curve becomes almost vertical. Thus while dry wheat will take up moisture and come very quickly to equilibrium at low humidities, the opposite process of desorption is extremely slow.

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May 28.

[1] Coleman, D. A., and Fellows, H. C., *Cereal Chem.*, 2, 275 (1925).

[2] Gane, R., *J. Soc. Chem. Ind.*, 60, 44 (1941).

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[11] Glückauf, E., *Nature*, 154, 831 (1944).

Cosmic Rays and Kinematical Relativity

MILNE[1] suggests that the undulatory component of cosmic rays may be the remains of the radiation of very high frequency the existence of which in the remote past I postulated[2] in connexion with the origin of the planets. I do not think that this idea can be accepted without a slight modification which, however, covers the particulate component as well. Consider a photon such as I postulated which had an energy of 6×10^{44} ergs at time $t=2 \times 10^{-63}$ sec. If it reached the earth to-day, then at that time in the past it was in the neighbourhood of a galaxy receding from our own with almost the speed of light. Now, that is to say, with $t = 6 \times 10^{16}$ sec., its energy has been degraded by a factor of 3×10^{-80} by the Doppler effect, and is therefore only 2×10^{-34} erg. This is so even if it has undergone reflexion or refraction. Whereas the energies of cosmic ray photons may exceed an erg ($0 \cdot 6 \times 10^{12}$ electron-volts) and certainly exceed 10^{-6} erg. Moreover, each of the postulated past photons must now be represented by a very large number of photons, perhaps of the order of 10^{48}.

All these difficulties can be overcome if the energy of the cosmic rays has spent a large fraction of the dynamical time since the origin of the solar system not as the electromagnetic energy of radiation, but as the kinetic energy of moving particles, which, according to kinematical relativity, undergoes no degradation like that due to the Doppler effect. During dynamical time τ the energy of a photon relative to matter in its neighbourhood is degraded by a factor $e^{-\tau/t_0}$, where t_0 is about 2×10^9 years. In 3×10^{11} dynamical years most cosmic rays would pass through many galaxies, encountering gas or dust clouds much denser than any matter which may exist between the galaxies, giving opportunities for the transfer of energy between particles of different types, and between particles and photons, and also for the sharing of the energy of one particle or photon among a number of particles. All these events occur in our own atmosphere. Without further data one cannot be precise, but it would seem that most cosmic rays have spent most of dynamical time as particle energy rather than photon energy.

In fact, once the energy spectra of the several cosmic ray components which enter the atmosphere are known, it may be possible to calculate the corresponding spectra at a much earlier date by processes similar to those which are used in calculating the spectra of the 'primary' extra-atmospheric radiation from that at sea-level. If such calculations lead to reasonable consequences, it will be possible to accept the above hypothesis as a provisional account of the history of cosmic rays.

In a recent letter[3] Prof. Dingle suggests that I have been wasting my time in making unverifiable deductions from kinematical relativity. If these deductions are unverifiable I have certainly wasted my time, however true this theory may be. I venture to think that, since the theory which I have briefly adumbrated has fairly wide consequences for stellar evolution, it will be capable, if not of complete verification, at least of observational disproof if it is untrue. If it is so disproved, it may constitute a *reductio ad absurdum* of Milne's theory. In this case I am sure that Prof. Dingle will agree that the time spent in slaying such a Jabberwock has not been wasted.

For I cannot help suspecting that it has survived Prof. Dingle's vorpal blade. He writes that kinematical relativists cannot legitimately explain the Doppler effect by the relative motion of a light source and an observer, since a change of time-scale reduces relative motion to rest, and "we cannot attribute an objective fact to a cause destructible by an arbitrary act on the part of the thinker". This is only true if the arbitrary act does not substitute an equally valid cause (using his terminology, which is perhaps not the best possible in this context). If I break my nose on a lamp-post in the black-out I usually say that it was at rest and I ran into it. If I adopt egocentric co-ordinates I can say that I was at rest and it ran into me. If I use geocentric co-ordinates, I can say that it was moving eastwards at 648 m.p.h. and overtook me since I was only moving eastwards at 645 m.p.h. But all these accounts of the collision lead to the same calculable impulse on my nose. Milne's transformation is a deeper one, since relative motion is not invariant under it. But provided it leads to the same predictions of observable events, as (*pace* Prof. Dingle) it does, it would seem to be scientifically legitimate.

I do not think that it will be rejected on such grounds as Prof. Dingle suggests. But it will certainly be rejected if it consistently leads to false predictions of observable phenomena. At present our most powerful telescopes can only photograph light about 200 million years old, that is to say Permian light. As our backward range in time increases, the divergence between datings on the kinematical and dynamical scales will also increase, and it will become increasingly easy to reject theories which depend on this divergence, should they prove incorrect.

The agreement or disagreement with fact of calculations concerning cosmic rays will also serve as a test of the correctness of Milne's theory.

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[1] *Nature*, 155, 135 (1945).

[2] *Nature*, 155, 133 (1945).

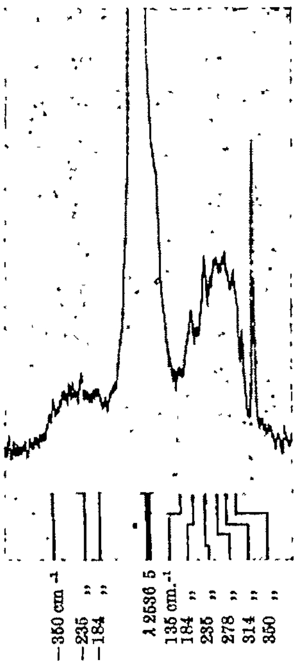
[3] *Nature*, 155, 511 (1945).

Raman and Infra-red Spectra of Rock-salt

Rasetti[1] succeeded in recording a Raman spectrum with rock-salt, using the 2537 A. radiations of the mercury arc as exciter. But as neither his preliminary report nor his subsequent paper with Fermi[2] gives quantitative details of the spectrum, it appeared desirable to investigate the subject afresh. In seeking to record the Raman effect with rock-salt, the presence of a disturbing effect became evident, namely, a luminescence exhibited by the crystal attended by the development of a fugitive coloration under the action of the ultra-violet rays. As the Raman spectrum is itself feeble, it is partially masked or even completely overpowered by the continuous spectrum of the luminescence. Ultimately, however, a specimen of rock-salt was found which was non-luminescent. Using this specimen, and with a fine slit which made prolonged exposures necessary, a spectrogram was obtained in which much more detail could be seen than in the picture reproduced with Rasetti and Fermi's paper. As is evident from its microphotometric record here reproduced, the spectrum consists of a series of Raman lines distinctly resolved from each other. The frequency shifts from the parent radiation of the more prominent of them are 135, 184, 235, 278*, 314* and 350* cm.$^{-1}$, while there are feebler lines with frequency shifts 202 and 258 cm.$^{-1}$. Further, there are indications that the three lines marked with an asterisk possess imperfectly resolved components.

It is worthy of note that Barnes and Czerny[3], investigating the infra-red absorption spectrum of sputtered films of rock-salt, found, besides the principal absorption peak at 163 cm.$^{-1}$, other absorption peaks at 190 and 245 cm.$^{-1}$, the latter being the more prominent. The experimental method of locating these peaks is sufficiently uncertain to justify our identifying their positions, at least tentatively, with that respectively of the two lines with frequency shifts 184 and 235 cm.$^{-1}$ which appear very prominently in the Raman spectrum. There is no Raman line with a shift 163 cm.$^{-1}$ corresponding to the frequency of the principal infra-red absorption; but this is not surprising as symmetry considerations[4] indicate that it should not appear in light-scattering. We may, however, tentatively identify the Raman line with frequency shift 314 or one of its components as the octave of the principal infra-red active vibration frequency.

The appearance with rock-salt of numerous clearly defined and well-resolved Raman lines, other than the octave of the so-called 'fundamental frequency' of the lattice, is clearly a matter of great theoretical interest. The theories of light-scattering in crystals[5,6] which are based on Born's postulate of the cyclic lattice, lead to the result that only the infra-red vibrations the length of the phase-waves of which satisfies the well-known Bragg formula in relation to that of the light waves, can give an observable effect. This is equivalent to the statement that only the so-called 'fundamental vibration frequencies of the crystal lattice' can appear in the Raman effect, and that all others are excluded. Pursuing the same train of thought to its logical conclusion, it can readily be shown that if the second-order terms in the variations of optical polarizability and/or the anharmonicity of the vibrations are considered, octaves and/or combinations of the 'fundamental vibration frequencies' may appear, and no others.



Microphotometric record of the Raman spectrum of rock-salt

In the attempt to escape the contradiction with the experimental facts which is manifest, we may give up the assumption (inherent in the postulate of the cyclic lattice) that the infra-red vibrations have coherent phase-relations over extended volumes in the crystal, and limit the region of assumed coherence of phase to volume elements the dimensions of which are large compared with an individual lattice cell, but are smaller than the wave-length of light. Even this change in the basis of the theoretical approach, however, does not resolve the difficulty. For, on the new basis, the entire continuous spectrum of the crystal as deduced from the Born dynamics should manifest itself as a second-order Raman spectrum of octaves and combinations. What we actually get, however, is something very different, namely, a set of discrete lines.

The contradiction between the experimental facts as observed with rock-salt and the consequences of the Born crystal dynamics would, therefore, seem to be inescapable.

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May 28.

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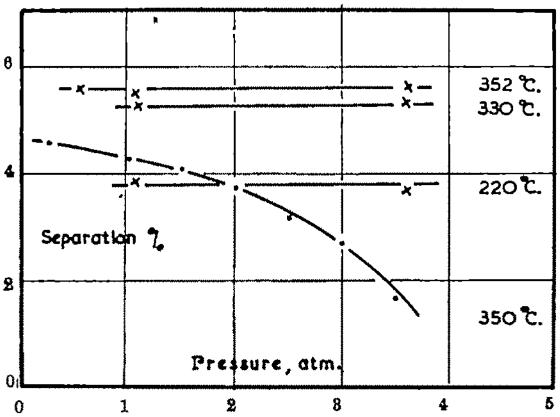
[6] Tamm, I., *Z. Phys.*, **60**, 345 (1930).

Effect of Pressure on Thermal Diffusion in Gases

Because of the present interest in the industrial application of thermal diffusion to the separation of gases, it is perhaps desirable to report some work concerned with the effect of pressure on the thermal diffusion process.

Schmahl and Schewe published measurements[1] of the separation produced by thermal diffusion in mixtures of hydrogen and hydrogen sulphide, and of hydrogen and carbon dioxide. The gas mixture was contained in two cylindrical bulbs, 2 cm. in diameter and 21 cm. and 7 cm. in length respectively. The bulbs were connected by a 5 mm. bore tube, 12 cm. long, which included a stopcock. While the larger vessel was heated in a furnace, the other was maintained at 20° C., and when equilibrium was attained the contents of the two bulbs were separately removed and analysed. The separation, that is the difference in composition of the gas in the two bulbs, found in this way in a hydrogen – carbon dioxide mixture at about 1 atm. pressure agreed well with values found by others. But measurements made at higher pressures showed a marked dependence of the separation on the gas pressure. Between 1 atm. and 3·5 atm. pressure the separation decreased by 50 per cent; it appeared that it would vanish at about 4 atm. pressure.

This result is unexpected. Theoretically, the separation is independent of the pressure, at least so long as multiple collisions among the molecules are negligible, and measurements over a small range of pressure[2] had so far confirmed the theory. Further measurements have therefore been carried out over the same range of pressure as in Schmahl and Schewe's experiments. An apparatus already described[3] was suitably modified and separation measurements for a hydrogen – carbon dioxide mixture containing 44 per cent hydrogen were made at pressures up to 3·6 atm. The gases were taken directly from cylinders, but the small amount of impurity is unlikely to be important. The results are shown in the accompanying graph, together with those of Schmahl and Schewe for a hydrogen – carbon dioxide mixture containing 32 per cent hydrogen. There is no indication of a pressure effect in the present measurements.



SEPARATION AS A FUNCTION OF PRESSURE FOR HYDROGEN – CARBON DIOXIDE MIXTURES.

—.—.— Schmahl and Schewe; 32 per cent hydrogen.

—x—x— Present results; 44 per cent hydrogen.

Temperatures refer to heated bulb; other bulb at 20° C. in all cases.

The explanation of the results of Schmahl and Schewe is not obvious, though it seems possible that insufficient time was allowed for equilibrium to be reached before the analyses were made. Experience in the present work suggests that, at the higher pressures, even the ten hours which Schmahl and Schewe sometimes allowed might be inadequate for separation to become complete in the long bulbs of small cross-section which they used.

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[1] *Z. Elektrochem.*, 46, 203 (1940).

[2] Ibbs, Grew and Hirst, *Proc. Phys. Soc.*, 41, 456 (1929).

[3] Grew, K. E., *Proc. Roy. Soc.*, A, 178, 390 (1941).

Logarithmic Scales

THE suggestion recently put forward[1] that a logarithmic scale should be used for high-vacuum measurements directs attention to the fact that, while increasing use is being made of logarithmic scales as a basis of comparison, there is no generally recognized notation for this purpose.

The convenience of the decibel, as used in electrical communications, has prompted workers in other fields to adapt it to their own requirements; but in many cases this cannot be done, owing to the restrictions with which the decibel has, very properly, been circumscribed, making it solely a measure of relative energy flow. These restrictions increase its utility for the purposes of the telephone engineer, but preclude its use as a general method of expressing a ratio on a logarithmic basis.

Some form of logarithmic notation, corresponding to the decibel, can often be used with advantage wherever the response to a given excitation is either basically exponential or conveniently predictable as the product of a number of component factors. But to be most effective the notation should be as free from special restrictions as the older percentage basis of comparison.

For such a purpose, it is suggested that the term 'decilog' might be used, the decilog (dL) being analogous in all respects to the decibel, except that there is no restriction on the nature of the quantities being compared.

In most cases, one of these two quantities would be the reference level. Thus, a vacuum measurement would be expressed as so many decilogs below one bar, and the intensity of a physiological stimulus as so many decilogs above the threshold intensity, giving, incidentally, a linear response in terms of the Weber-Fechner law.

Again, in the design of technical amplifiers and electrical networks for purposes other than communications, voltage is frequently of more significance than power, and the impedance level may vary widely. In such circumstances, the gain or loss in decibels is meaningless, and the performance could more usefully be expressed in decilogs on a voltage basis.

There does, therefore, appear to be a need for some notation of this kind, and its general adoption would avoid the creation of a multiplicity of special 'units' to meet each individual application.

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[1] *Nature*, 155, 545 (1945).

Frictional Properties of Wool Fibres

IN the course of work on the felting properties of wool a simple apparatus has been devised to examine the frictional properties of individual fibres in selected fluids. To each end of the clean fibre is fixed a copper hook (0·1 gm.) by means of molten shellac. The fibre is then suspended over a cylindrical rod of polished keratin (in the present experiments rhinoceros hide, diameter 7 mm., was used), and the requisite solution is allowed to drop rapidly on to the fibre-rod junction. A bent glass rod in contact with the underside of the cylinder carries away the used solution. Weights made from calibrated pieces of wire are then gradually added to one of the hooks until, with careful observation, preferably through a magnifying eyepiece, the fibre just commences to slide. The experiment is then repeated using the other hook and causing the fibre to move in the opposite direction.

In this way the forces required to slide the fibre with the scales and against the scales can be determined to the nearest 0·01 gm. The coefficient of friction in either direction is then calculated from the formula $W_1/W_2 = e^{\mu\pi}$, W_1, being the total load in the direction of motion and W_2 the weight of the hook plus shellac on the other end of the fibre. The above formula is dependent upon continuous contact between the fibre and the fixed surface and would not be applicable if the fibre is held at a few isolated points on the surface. That there is a continuous contact is evident from the reproducibility of results and from the gradual motion of the fibre, which is usually of the order of 0·5–3·0 cm. per minute. The effect of variations in the total load has been studied, and it has been found that variations within the range used (0·25–0·70 gm.) do not seriously alter values for the coefficient of friction. The method has been found to be inapplicable to dry surfaces.

Results obtained with fibres from untreated wool (64's quality Merino) and from the same wool when treated by some of the commercial unshrinkable processes are set out in the accompanying table. The solution used contained 0·2 per cent soap and 0·1 per cent sodium carbonate, and had a *p*H value of 10·7, the temperature being 30–35° C.

FRICTIONAL MEASUREMENTS ON UNTREATED AND NON-FELTING WOOLS.

Anti-scale coefficient $= \mu_1$

With scale coefficient $= \mu_2$

Directional coefficient $= \frac{\mu_1 - \mu_2}{\mu_1 + \mu_2}$ (term adopted by Mercer[1]).

Treatment	μ_1	μ_2	$\frac{\mu_1 - \mu_2}{\mu_1 + \mu_2}$
Untreated	0·28	0·10	0·47
	0·37	0·16	0·40
	0·34	0·15	0·39
Sulphuryl chloride	0·16	0·15	0·03
	0·18	0·13	0·16
	0·19	0·15	0·12
Aqueous bromine	0·16	0·13	0·10
	0·15	0·11	0·15
	0·17	0·13	0·13
Alcoholic KOH	0·38	0·20*	0·31
	0·49	0·20*	0·42
	0·39	0·22*	0·28

* Fibre tended to slide abruptly during these measurements.

The results for sulphuryl chloride and bromine treatments agree in general with those of previous workers[1,2] using other techniques, and show that these reagents markedly reduce the directional coefficient of friction.

Treatment with alcoholic potash has caused no major reduction in the directional coefficient, which indicates that this reagent probably produces its unshrinkable effect in a manner different from the others. Further work is in progress on this subject.

I am indebted to Messrs. M. R. Freney and E. H. Mercer for helpful discussions, and to Miss P. Howard for assistance with the experimental work.

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[1] Mercer, E. H., *Nature*, 155, 573 (1945).

[2] Whewell, C. S., Rigelhaupt, L., and Selim, A., *Nature*, 154, 772 (1944).

An Illusion of Size

I READ Dr. A. Loewenstein's letter[1] at the time of publication, and some of my colleagues and I repeated his experiment and, on the whole, confirmed his observations. Prof. H. Hartridge[2], however, appears to have experienced "An Illusion of Size" much greater than we could observe. I am quite at a loss to see how Prof. Hartridge obtained the measurements he quotes.

The nickel-brass threepences are made to a diameter across the flats of 0·823 in. or 21·082 mm.; from 1942 onwards the corners have been slightly rounded, so that the diameter over these is 0·860 in. or 21·844 mm. instead of the theoretical 21·872 mm. calculated for a dodecagon; earlier coins had nearly, but usually not quite, sharp corners.

These coins are struck from round blanks and are expanded into a dodecagonal steel collar in the coining press. A working tolerance of + 0·005 in. (0·077 mm.) is allowed in the dimensions of these collars, but this difference is, of course, far too small for visual observation.

It appears to me that the probable explanation of the 'illusion' is that the raised edge of the coin is not flat but considerably rounded, especially towards the edge of the coin, so that the reflexion of narrow-angle illumination appears as a bright line about half the width of the raised edge; the outside of this line would, in suitable conditions, be perceived as the edge of the coin, thus giving the illusion of smaller diameter.

When the coin is placed on a black surface, the reflexion from the extreme edge will be of that surface, and in suitable conditions would not be visible.

The edges of all coins become rounded in circulation, which may explain Dr. Loewenstein's observations on shillings.

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[1] *Nature*, 155, 672 (1945).

[2] *Nature*, 156, 118 (1945).

Occurrence of Hexadecatrienoic Acid in the Glycerides of Rape (*Brassica napus* L.) Leaf

THE unsaturated acids of leaf lipids have been shown to consist of octadecatrienoic (linolenic) and octadecadienoic acid[1], together with traces of oleic and palmitoleic acid[2].

In the course of ester fractionation analyses of leaf glycerides, it was found that the C_{16} unsaturated methyl esters of rape had abnormally high iodine values (*c*. 190) as compared with 94·8 required for methyl palmitoleate.

Crystallization of the methyl esters from 15 volumes of methyl alcohol at − 15° C. and fractionation at 0·1 mm. through an efficient column yielded a fraction with sap. equiv. 264·0 and iodine value 225·9. Further concentration of the C_{16} polyethenoid fraction was achieved by systematic crystallization of the lithium salts of the acids (8·4 gm.) from acetone. The less saturated acids were removed by crystallization from 90 per cent acetone at 10° C. and then the lithium salt of hexadecatrienoic acid was precipitated from 95 per cent acetone at − 5° C. Under these conditions impurities of lower iodine value remained in solution. From this concentrate methyl esters were prepared which on distillation at 0·1 mm. yielded 4·4 gm. of esters (sap. equiv. 263·2, iodine value 271·9; theory for methyl hexadecatrienoate, sap. equiv. 264, iodine value 288·5).

Hydrogenation of the methyl esters in the presence of nickel formate at 230° C. yielded methyl palmitate (m.p. 29°, not depressed by admixture with genuine methyl palmitate).

Bromination of the acids in ether at − 10° C. yielded 72 per cent ether-insoluble bromides, m.p. 181° C. (per cent Br = 64·3, as compared with 64·5 per cent required for hexabromopalmitic acid).

Ester fractionation analysis showed the following composition for two samples of rape fatty acids from the lipids soluble in acetone at 0° C. The fatty acids comprised respectively 1·14 and 1·15 per cent of the total dry matter and 24·3 and 23·1 per cent of the total lipids.

	Saturated	Unsaturated		
	(mainly palmitic)	C_{14}	C_{16}	C_{18}
Weight per cent	16·0	0·7 (2·0 H)	11·3 (6·0 H)	72·0 (5·4 H)
	15·1	0·5 (2·0 H)	17·1 (6·0 H)	67·3 (5·2 H)

The value for the mean saturation of the C_{16} unsaturated acids has been calculated as 6·0, but this figure is only approximate, since small proportions of other less unsaturated acids may be present.

Apart from the inclusion of hexadecatrienoic acid, the fatty acid composition of rape glycerides is shown to be not dissimilar from that of forage grasses[2], which from investigations to be reported elsewhere do not contain significant proportions of this constituent.

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[1] Smith and Chibnall, *Biochem. J.*, 26, 218 (1932).

[2] Shorland, *Nature*, 153, 168 (1944).

Rate of Entrance of Ammonia into Muscle Fibres in Relation to Carbon Dioxide Tension

FROM previous considerations[1] the following Donnan relation may be expected to apply across the muscle fibre membrane:

$$k_1/k = [NH_4]_1/[NH_4]$$

where k_1 and k are the potassium concentrations within and without, and similarly for the ammonium ion.

In a communication some years ago[2], it was pointed out that with an external concentration of 1 mgm. of ammonia nitrogen per 100 ml. a ratio of about 2·1 was reached across the membrane when the external concentration was 30 m.eq. per litre, and the k_1/k value could be expected to be about 4·0 (the high external K was used to prevent K losses). The result was interpreted then as a probable damage to the membrane resulting from high internal ammonia concentrations.

Later investigations have brought to light some striking facts. First, if the external ammonia be decreased below 1 mgm. ammonia nitrogen per cent under the same conditions, the ammonia ratio increases more and more until it equals that of potassium. This would be in agreement with the view that high internal ammonia concentrations were in some way affecting the balance or the permeability of ions. In addition, when we came to measure the rate of passage of the ammonium ion as described in a previous communication[3], and using no carbon dioxide or bicarbonate but a little phosphate, we got no measurable rate of ammonia entrance over several hours at room temperature. We varied in turn the details of the experiments and obtained the same results. We then carried out experiments with 5 and 15 per cent carbon dioxide, maintaining the *p*H constant by substituting the required fraction of sodium chloride by sodium bicarbonate. A great difference resulted in the rate of ammonia entrance, and with 15 per cent carbon dioxide it exceeded that of potassium chloride (without the latter being appreciably affected). This was proved by direct analyses as well as by observing the volume change.

The experiments recall the interchange of potassium and ammonia in yeast which occurs only in the presence of carbon dioxide. (The effect of carbon dioxide was many times repeated and there appears no doubt about it. A few experiments by Fenn *et al.*[4] under different conditions would appear to indicate a different result, but these cannot be fully considered here.)

From such experiments it is clear that the undamaged muscle fibre membrane is either impermeable to the ammonium ion or is very slowly permeable, but that a great facilitation of entrance can be produced by carbon dioxide. Into ammonia equilibria or steady states across the muscle fibre membrane there enters a complexity quite absent from the simpler potassium, rubidium, chlorine, bromine, bicarbonate and hydrogen ion relationships.

The experiments of Fenn *et al.*[4] are open to question on several important points. For example, under their conditions it can be shown that numbers of fibres are losing their differential permeability for potassium and sodium throughout, and that this loss is irreversible, a very confusing complexity being established. It may also be noted that a misleading statement occurs in their paper to the effect that since potassium diffuses out slowly from isolated immersed muscle (in ordinary Ringer fluid) the ratio of potassium ions across the membrane can be made anything one pleases by changing the external K, and it has therefore no significance. If, by this, it is intended to convey that K ratios in general across the membrane have no significance, we do not see how such can be seriously maintained in view of the evidence already considered[1].

At and above the external maintenance K level, a definite K ratio is reached and maintained for long periods (48 hours in the cold). Such ratios are in full accord with the theoretical treatment of a membrane permeable to potassium ions and small anions, but not to sodium ions and larger anions of the type of sulphate, or phosphate esters. It must be taken now as proved that the muscle fibre membrane is of such a kind, unless we are prepared to entertain very fantastic hypotheses.

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[4] Fenn, W. O., Haege, L. F., Sheridan, E., and Flick, J. B., *J. Gen. Physiol.*, 28, 53 (1944).

ROYAL SOCIETY OF CANADA

ANNUAL MEETING

THE meeting of the Royal Society of Canada for 1945 was held at Queen's University, Kingston, Ontario, during May 20–23, under the chairmanship of the president, Prof. J. K. Robertson, professor of physics at Queen's University. In the scientific sections, one hundred and four fellows, and half as many guests, were in attendance.

In addition to sectional and business meetings, there were two largely attended evening meetings. On the evening of May 21, the Society's medals were presented. Prof. R. B. Thomson, University of Toronto, received the Flavelle Medal as a tribute to his work on the comparative anatomy and physiology of plants. The Henry Marshal Tory Medal was presented to Dr. Otto Maass, professor of physical chemistry at McGill University, assistant to the president of the National Research Council, and director of chemical warfare and smoke for the Department of National Defence. He was hailed as a man possessed of experimental skill and scientific imagination, with a fondness for hazardous experiment, who has played a leading part in planning chemical research in Canada since the outbreak of the War. The Willet G. Miller Medal was given to Dr. M. E. Wilson, Geological Survey, Ottawa, who, conspicuous among Precambrian geologists of the world, has done much in Canada in the development of mining. The Lorne Pierce Medal was awarded to L'Abbé Felix Antoine Savard, Laval University, and the Tyrell Medal to Prof. F. Landon, University of Western Ontario.

After the presentation of medals, Prof. J. K. Robertson delivered his presidential address on "Continuity and Discontinuity". The paper was divided into two parts: a discussion of the progress of philosophical opinion down to the eighteenth century, followed by an assessment of the development of the two conceptions by physicists up to the present day. Recognizing that "present-day physics continues to demonstrate the inter-play of continuity and discontinuity", he concludes that "The modern physicist no longer accepts a materialistic philosophy and no longer assumes that, as time goes on, he will learn more and more about the ultimate details of a real objective world. His advances have shown him that measurements and observations can not give him exact knowledge beyond a certain stage, and hence for him, what is beyond has no meaning. His aim now is the more modest one of describing facts and observations in terms of correlating laws, which in the last analysis can be expressed accurately only by mathematical symbols".

On the evening of May 22, following a complimentary dinner given by the Mayor and City Council of Kingston, a popular lecture, "Biological Control of Insect and Plant Pests", was given by Dr. W. R. Thompson, Imperial Parasite Service, Belleville, Ontario. This paper so impressed the audience that a resolution was passed at a general meeting next day expressing to the Imperial Institute of Entomology its appreciation of the work done in Canada during the War, and asking that arrangements be made for its continuation.

In Section I, twenty-one papers were presented on subjects of historical or literary interest in French Canada.

In Section II, the presidential address by Prof. W. H. Alexander was a provocative discussion of some obvious incompatibilities of temperament as between the ideals of a genuine education and the spirit of the ultra-democratic State as suggested by Plato's "Apology to Socrates". Papers were read in the fields of literature, philosophy, history and the social sciences. Anthropology and archæology were represented by papers on "The Distribution of Rubbed Slate Instruments in Eastern Canada" by Dr. Douglas Leechman, and by the myth of "Bear Mother" by Dr. Marius Barbeau. A timely paper was presented by Prof. R. Flenley, "The Results of the Reformation in Germany".

In Section III, the most important feature of the meeting was a symposium on the dimensions of the galaxy. This subject was first treated very ably by Dr. Helen Sawyer Hogg from the point of view of the observations on globular clusters. Dr. C. S. Beals dealt with the obscuring matter between the stars and its influence on estimates of galactic dimensions. These papers led up to the presidential address by Dr. J. A. Pearce, of the Dominion Astrophysical Observatory, entitled "The Dimensions of the Galaxy as Derived from Studies of Galactic Rotation", in which he reviewed the history of the subject from the time of Herschel to the most recent estimates.

Thirty-five other papers were presented to this Section, ten by title. A notable series of ten chemical papers was presented by Prof. Paul-E. Gagnon, of Laval University, Quebec, ranging from the synthesis of amino-acids to the technology of charcoal, and exhibiting the great activity in chemistry at that institution. Prof. William Ure, of the University of British Columbia, described the mechanism of the 'flotation process' of concentrating ores, showing the necessity of a water-repellent layer on the surface of the mineral. Prof. J. K. Robertson, Queen's University, described the effect of high-frequency discharges in producing patterns in thin layers of metal placed in the discharge tube. Five meteorological papers were read by members of the staff of the Meteorological Service of Canada, including a new theory of the mechanism of the 'Chinook' wind (the warm dry wind which frequently descends the eastern slope of the Rocky Mountains in Alberta) by D. H. Smith and C. E. Thompson.

Nineteen papers were presented to Section IV. In the presidential address, Dr. J. S. DeLury gave an outline of a hypothesis to explain crustal movements. In his opinion, the earth's crust is strong to a depth of 450 miles or more. Liquid rock, known as magma, and as lava when it reaches the surface, is formed in shallow levels by frictional heat generated in crustal movements, and is not inherited from a primitive molten earth. These movements are due to failure in the crust caused by thermal contraction followed by a very protracted process of collapse.

Dr. A. W. Jolliffe presented evidence that, geologically, the north-western part of the Canadian Shield may be divided into four sub-provinces. From north to south these are: (1) Great Bear—characterized by Proterozoic formations, north-east faulting with right-hand displacements, and uranium–silver–cobalt–nickel–copper mineralization; (2) Yellowknife—characterized by Archæan formations, north to north-west faulting with left-hand displacements, and gold mineralization; (3) East Arm—characterized by chiefly Proterozoic formations, north-east faulting, and copper–cobalt–nickel–gold mineralization; and (4) Taltson—by both Proterozoic and Archæan formations, north to north-west faulting, and silver-lead-gold mineralization.

Dr. T. L. Tanton offered a theory, based on a study of conchilites and the work of W. D. Francis, suggesting the steps whereby non-living matter may have evolved into semi-living organisms, which provided the catalyser for the synthesis of protein and the conditions that induced the evolution of primeval forms of life. Dr. M. L. Keith described brucite deposits in the Rutherglen District, Ontario. Franco Rasetti reported the discovery of Middle Cambrian fossils in the Gaspé, the first recorded in the Province of Quebec. Dr. R. F. Legget described the geology of the "Shipshaw" area on the Saguenay River, and reported finding wood and other organic matter imbedded in the clay. Peter Ginn described an ultrabasic rock near Lochalsh, Ontario.

Dr. Robert Newton, president of Section V, in discussing the northern limits of wheat production, pointed out that wheat production in Canada is mainly confined to the southern plains region of the Prairie Provinces. Its possible northward extension concerns not only the potential world food supply, but also the feasibility of northern settlement. The longer summer days of northern latitudes are favourable to growth, but their value is reduced by association with lower temperatures. Rainfall is another important modifying factor. Moreover, the milling and baking quality of northern wheat is generally inferior. This may not destroy its usefulness as a local food resource, but makes it unsuitable as an article of commerce.

Prof. R. B. Thomson, who was awarded the Flavelle Medal, presented a paper entitled "Food Supply and Budding or Twinning Embryogeny". Prof. Thomson believes that the view that the asexual type of embryo initiation involved in budding or twinning embryogeny is due to recent mutation is not supported by sufficient evidence; whereas that for its being an innate or constitutional potentiality is satisfactory. The expression of this potentiality, however, is generally kept under control as indicated by the prevalence of simple embryogeny (one embryo from one zygote) in the main lines of evolutionary advance. Thus the problem of accounting for the sporadic occurrence of budding or twinning at different levels in such advance is concerned with the elimination of established control. This has been effected in animals by various physical and chemical experimental procedures. Up to the present, however, little attention has been given to the influence of food supply, and some experimental and other evidence, particularly the effect of excess nutrition on the production of a free nuclear stage in embryos normally undergoing simple embryogeny, indicates the importance of giving more attention to the possibly broader significance of this factor.

Dr. W. H. Cook, director of the Division of Applied Biology of the National Research Council, discussed some of the War research projects of the Council under the title "Some Wartime Food and Supply Problems". Under war conditions the main problem in feeding civilian or Service personnel is that of transport and distribution, complicated by the perishability of many foodstuffs. To meet the emergency, facilities had to be improvised to preserve the product, or alternatively the foodstuffs themselves had to be rendered less perishable. The dehydration of foodstuffs rich in proteins and fats was discussed in relation to the measurement and maintenance of quality and the type of deterioration that occurs. Several new chemicals required by war industry can be provided by the fermentation of starch. Reference was made to the bacterial fermentation yielding 2,3-butanediol, a material readily converted to butadiene and other chemicals.

Thirty-eight other papers on various phases of biological and medical sciences made up the programme of Section V. These included an important communication by Dr. B. P. Babkin, describing the interference of quinine bisulphate with cholinergic mechanisms in the heart and stomach of the dog, and a demonstration by Dr. C. C. Macklin that venule capacity in the lung is increased on inspiration.

Fifteen new fellows were presented, including the following in the Scientific Sections: Section III (Chemical, Mathematical and Physical Sciences): R. Brauer, E. W. Hewson, O. J. Walker; Section IV (Geological Sciences): V. J. Okulitch, J. E. Thomson, H. V. Warren; Section V (Biological Sciences): E. W. Crampton, J. Labarre, W. Leach, C. A. Mitchell, A. W. H. Needler, D. Y. Solandt.

Officers for 1945–46 were elected as follows: *President*, Prof. E. S. Moore, University of Toronto; *Vice-President*, Prof. H. A. Innis, University of Toronto; *President of Section I*, Dr. S. Marion, Ottawa; *President of Section II*, Prof. D. C. Harvey, Dalhousie University, Halifax; *President of Section III*, Prof. C. T. Sullivan, McGill University; *President of Section IV*, Dr. B. R. MacKay, Ottawa; *President of Section V*, Dr. B. P. Babkin, McGill University.

MODE OF ACTION OF PENICILLIN

SOME of the more recent work on the mode of action of penicillin was briefly reviewed in *Nature* (155, 403, March 31, 1945). Work noted there established the fact that penicillin is not merely bacteriostatic but also can actively destroy some micro-organisms. This bactericidal effect appears to be exerted especially upon the young bacterial cell and upon feeding bacteria, and to be therefore conditioned by certain factors in their environment. A leading article in the *Lancet* (276, March 3, 1945) summarizes the facts about this question which were available up to that date.

Important recent papers have since appeared. Thus E. Chain and E. S. Duthie (*Lancet*, 652, May 26, 1945) point out that Fleming, in his original paper on penicillin, recorded its slow bactericidal effect on *Staphylococcus* and its lytic effect under certain conditions. They explain that the original statement by the Oxford workers that penicillin is mainly bacteriostatic was based on the fact that it did not affect the oxygen uptake of resting *Staphylococcus*, for large numbers of viable colonies were found after incubation with penicillin in Ringer solution for twenty-four hours. They then review work done in the United States, which demonstrated that penicillin is bactericidal, but that it is not so under unfavourable conditions (such as low temperature or exhausted media) and that its bactericidal effect can be increased by substances which enhance bacterial growth and decreased by substances which interfere with bacterial growth (for example, sulphadiazine). From the results of their own work recorded in this paper, Chain and Duthie conclude that, during the resting phase of *Staphylococcus*, even large concentrations of penicillin have no effect on the oxygen uptake. During the early lag phase, however, and during the logarithmic phase of multiplication, penicillin has a strong inhibitory effect, and eventually completely stops the oxygen uptake, even in small concentrations (0·04–0·1 units per c.c.). They also demonstrated a strong bactericidal effect in the early lag phase and the logarithmic multiplication phase, but no measurable bactericidal effect during the resting phase. This confirms American work. Chain and Duthie conclude that penicillin can exert a bactericidal effect on *Staphylococcus* before actual division occurs, but that the organism can undergo at least one division in the presence of penicillin when it is added during the logarithmic phase of multiplication. It appears to interfere with some metabolic function of the early stages of bacterial development. Helvolic acid, the bacteriostatic antibiotic, antagonizes the bacteriostatic and bacteriolytic action of penicillin. Sulphanilamide and sulphamezathine, on the other hand, do not prevent the occurrence of several bacterial divisions and have no antagonistic effect on the bactericidal effect of penicillin on *Staphylococcus* and *Streptococcus*; on the contrary, they have a synergistic effect.

Chain and Duthie compare the modes of action of penicillin and the sulphonamides and review some of the literature upon this subject. They conclude that penicillin can kill *Staphylococcus* in the early lag phase before cell division has occurred, while sulphonamide kills only after several divisions have taken place in its presence. These results may be compared with those obtained by W. S. Miller, C. A. Green and H. Kitchen (*Nature*, **155**, 210, Feb. 17, 1945), who estimated the growth of the Oxford *Staphylococcus* turbimetrically in the presence of penicillin and sulphonamides and also discuss the effects of these two kinds of substance. They suggest that confusion may arise in discussions of bacteriostatic and bacteriolytic action because too fine a distinction is drawn between these two modes of action. Both penicillin and sulphonamides act by inhibiting cell multiplication; but, while sulphonamides inhibit the growth of almost every kind of cell as well as that of bacteria, there is little evidence that penicillin does this. Additional knowledge of the chemistry of penicillin may reveal that its mode of action is, like that of the sulphonamides, related to its chemical structure. It is unlikely that the mode of action of penicillin is unique; it is more likely that it differs from that of sulphonamides only in degree.

P. Bonét-Maury and R. Pérault (*Nature*, **155**, 701, June 9, 1945), using the differential photometer at the Radium Institute, Paris, suggest that, whereas the sulphonamide used by them (Dagenan 1162 F) does not stop but delays proliferation of *Staphylococcus aureus*, penicillin stops proliferation almost immediately, even at low concentrations, and that lysis follows. They found, however, that later a second proliferation occurred regularly, followed by a second partial lysis and then a second post-lytic growth. These results recall those obtained by J. W. Bigger (see *Nature*, **155**, 403, March 31, 1945). Bonét-Maury and Pérault obtained their results with six different penicillins (English, American and French). J. Hirsch (*C.R. Ann. Soc. Turque des Sci. Phys. et Nat.*, **12**; 1943–44) also studied the action of penicillin *in vitro* by manometric methods, and his work is discussed by Chain and Duthie (*loc. cit.* above). R. Knox (*Lancet*, 559, May 5, 1945) also concludes that the action of penicillin can be bacteriostatic, bacteriolytic or bactericidal, and that the young bacterial cell is particularly susceptible to penicillin. A. B. MacGregor and D. A. Long (*Nature*, **155**, 201, Feb. 17, 1945), studying the action of penicillin in relation to their work with penicillin pastilles (see *Nature*, 341, March 17, 1945), conclude that penicillin is bactericidal as well as bacteriostatic.

Very instructive also is the direct microscopical observation by Prof. A. D. Gardner (*Lancet*, 658, May 26, 1945), whose earlier work (*Nature*, **146**, 837; 1940) suggested that weak penicillin inhibited growth but did not prevent it, on the effects of penicillin on the spores of *B. anthracis* and *B. subtilis*. Gardner found that strong penicillin (50–100 units per c.c.) slowly kills the spores. Those of *B. anthracis* were more susceptible than those of *B. subtilis*, but neither were completely eliminated and there was no gross swelling. The spores gradually lost their high refractility and became empty ghosts. Weaker solutions of penicillin (0·1–1·0 units per c.c.) allowed the earliest phase of germination to occur, and the spores of *B. anthracis* then swelled up and became spherical coccoids which burst. Those of *B. subtilis* underwent similar changes, but all were not killed. Nevertheless, even the weakest inhibitory dose of penicillin renders the great majority of the spores non-viable. Spores studied in non-nutrient media were, however, little if at all affected, even by strong concentrations of penicillin, so that penicillin acts upon feeding bacteria and its action begins directly the bacteria begin to feed. Prof. Gardner concludes that the action of penicillin on sensitive species has little or no connexion with multiplication or division, although penicillin did cause abnormal divisions in sensitive *S. typhi* (long waists, spindle-shaped swellings, etc.). The majority of *Staphylococcus aureus* and *Streptococcus pyogenes* growing on agar are checked or killed before any visible growth or division has occurred. These conclusions, based upon direct microscopical examination, must carry great weight. It would seem that what is now required for a better understanding of the mode of action of penicillin is more exact knowledge of the chemistry of penicillin and the correlation of this, by the methods now being used for the biochemical analysis of micro-organisms, with the enzyme systems and other metabolic features of the organisms concerned.

G. LAPAGE.

RADIO WAVES FROM THE SUN

As the technique of radio-frequency measurement and application has progressed to successively higher frequencies, various investigators have from time to time turned their attention towards a demonstration of the interchangeability of thermal and radio methods of detecting electromagnetic waves. The use of normal radio receiving technique to detect thermal radiation from a hot body has always been an attractive line of experiment; and for this purpose, the sun, in spite of its great distance away from the earth, would appear to offer considerable advantages as a source of radiation of the desired type. The practicability of the reception and measurement of so-called 'cosmic noise' on an ordinary radio receiver has been demonstrated in various investigations, notably those described during 1932–39 by K. G. Jansky, who worked on frequencies of the order of 10–20 megacycles per second, and later (1940–44) by G. Reber, who described corresponding measurements made at frequencies of 160 Mc./s. In these cases, the investigators concluded that the radiation which they measured originated in interstellar space, and, from observations made of the direction of arrival, it was considered that the source of this cosmic noise was closely associated with the Milky Way. Both Jansky and Reber made attempts to observe any 'noise' radiation received from the sun, but although recently (*Astrophys. J.*, Nov. 1944) the latter investigator claims to have obtained definite evidence of this, the amount of such radiation received at the above frequencies is very small.

In a paper entitled "Microwave Radiation from the Sun" (*J. Franklin Inst.*, April 1945), G. C. Southworth describes some experiments conducted in the summer months of 1942 and 1943 in which a small but measurable amount of radiation from the sun was obtained with a conventional type of radio receiver operating on frequencies between 3,000 and 30,000 Mc./s. (wave-lengths between 1 and 10 cm.).

Following earlier work by Wien, Lord Rayleigh and Jeans, a complete formula for the energy distribution in the spectrum of a black-body radiation was derived by Planck from quantum considerations. At high temperatures and long wave-lengths, a condition of particular interest in the case of radio waves from the sun, the Planck relation reduces to the Rayleigh-Jeans formula. Applying this formula to the calculation of the energy distribution in the solar spectrum gives a result which is in general accord with experimental measurements throughout a considerable part of the visible and infra-red portions of the spectrum. The experimental results now described by Southworth tend to show that the same formula may be extended at least as far as the centimetre-wave portion of the radio spectrum.

These recent measurements were made at three wave-lengths between 1 and 10 cm. using an antenna within a parabolic reflector of high directivity and a suitable type of radio receiver. At the longest of the three wave-lengths the measurements of received power agreed to within about ± 5 per cent of that calculated by the Rayleigh-Jeans formula. At the intermediate wave-length the mean measured value was about 12 per cent below that calculated; while at the shortest wave-length, the mean observed level was approximately one-ninth of that calculated from the above formula. In no case was any marked diurnal variation observed such as occurs at infra-red wave-lengths, but at sunrise and sunset the received power varied more or less proportionally to the area of the sun's disk above the horizon; this transition period was passed through more slowly as the wave-length was reduced.

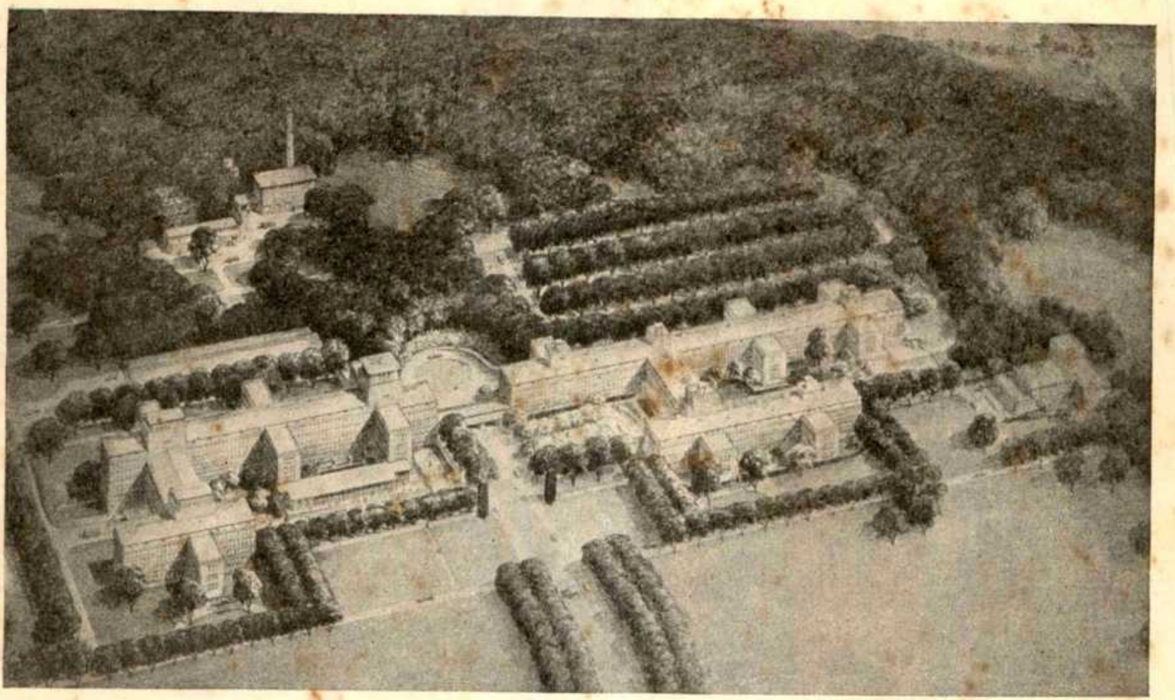
A particularly interesting part of the work described in Southworth's paper consisted of some directional measurements made by adjusting the receiver centrally on the sun and observing the decrease in output as the sun's disk moved out of the aperture of the receiving mirror. The effective angle of the latter, as measured by the displacement for which the received energy from a local source decreased to half the maximum value, varied from ± 3° for the longest to ± 0·3° for the shortest wave-length used in the experiments. In the measurements of solar radiation, the apparent aperture was much wider than this at the shortest wave-length, where it amounted to more than 0·8°, a result which is ascribed to the fact that the sun is an apparent disk and not a point source of radiation. At the lowest frequency, the angular diameter of the sun is small compared with the aperture angle of the receiver, but at the highest radio frequency used in this investigation, these two angles are comparable with one another. It may be expected that, to a first degree of approximation, the measured solar pattern will have a breadth equal to the sum of the aperture angle and the angular diameter of the sun. The fact that the observed directional pattern is even wider than this sum may be explained on the assumption that the angle of arrival of the waves from the sun varies rather rapidly over a considerable range; so that the sun appears to the receiver as a shimmering body the apparent diameter of which is considerably larger than the true diameter. This increase in apparent diameter may also account in part for the discrepancy between the measured and calculated energy levels already noted.

While carrying out the above work, it was found that the noise appearing in the output of the receiver was sensibly less when the receiver was pointed at the open sky above the horizon than when pointed at nearby objects or when it was located inside a room. The magnitude of this horizon effect for the longest wave used was of the order of 10^{-19} watts per sq. cm. for a band width of 1 Mc./sec. The corresponding energy measured from the sun was about five times as great. At the shortest wave-length used, this 'horizon' effect was barely measurable, while the energy received from the sun was about 5×10^{-18} watts per sq. cm. for the same band-width conditions. Numerous attempts were made to observe cosmic-noise coming from the general region of the Milky Way with the view of locating more precisely the source of the noise reported on by Jansky and Reber, but these attempts have so far proved unsuccessful on the higher frequencies used by Southworth. This experience tends to support Reber's view that cosmic radiation varies inversely as the frequency.

Perhaps the most interesting result of all this work is the establishment experimentally of a close relationship between black-body radiation and ordinary radio waves. Receiving from a source some 93 million miles away, it has been shown that the earth's atmosphere is fairly transparent to wave-lengths of the order of a centimetre, although there is evidence of absorption and scattering at the shortest wave-length at which observations were made. The next stage in the programme of investigation contemplated will incorporate the best ideas of both the radio engineer and the designer of astronomical equipment with the hope that additional accuracy will bring out features so far overlooked. Such observations on the transmission of radio waves through the earth's atmosphere from an outside source provide a means of investigating the structure of the atmosphere not previously available.

NEW BUILDINGS OF BELL TELEPHONE LABORATORIES

As soon as war restrictions permit, the facilities of Bell Telephone Laboratories at Murray Hill, N.J., will be greatly augmented, according to an announcement by Dr. Oliver E. Buckley, president of the Laboratories. The proposed addition is approximately the same size as the initial buildings, which were opened in 1941 and cost more than 2,000,000 dollars. The new building will extend the lines of the present one about five hundred feet in a



BELL TELEPHONE LABORATORIES AT MURRAY HILL, N.J. THE PRESENT BUILDINGS ARE ON THE RIGHT (SEE *Nature*, **151**, 674; 1943) AND THE PROPOSED BUILDINGS AT THE LEFT.

north-easterly direction. Old and new buildings will be joined by a bridge with a sheltered bus terminal beneath. The accompanying picture shows the architects' sketch of the complete building group with roadways and tree-shaded parking areas.

Since the present building was opened in the autumn of 1941, about one hundred groups from varied industries, Government departments, and some from abroad have come to study its new features. The unique requirement of a laboratory is that it must be designed for change. Prominent among new features which visitors come to see are the quickly movable partitions and the ease with which wires, cables and pipes may be installed or removed and yet concealed from view.

There are no permanent partitions in the buildings except those around the stair wells and elevator shafts. All others are built of easily movable metal panels. The outside surfaces of these units are sheet steel and they are separated by a 3-in. space which is packed with rock wool to prevent the transmission of sound and heat. Doors and transoms are made in one unit which can be interchanged with a partition in any part of the buildings. Along the outside wall of the buildings there is sheet steel wainscoting under the windows and up the piers between them. This is the same in appearance as the partition panels. The wainscoting is removable without special tools to give access to service pipes and wiring which are installed behind it. Similar wainscoting is applied around interior columns.

At intervals, small wings jut out from the main building providing well-lighted offices for physicists, chemists and engineers conveniently close to their laboratories. Shops, library, medical department and restaurant all fit into the pleasing functional pattern. The fields and woods, courtyards and shaded lawns all tend to make it a pleasant place in which to work.

People are all-important to an institution, the products of which are discovery, invention and design—creations of the intellect. In choosing this 200-acre site, the Bell Telephone Laboratories management sought a pleasant and healthful countryside in the midst of desirable home communities which spread over a wide area in towns along the Orange Mountain Range and the adjoining valleys. There is no intention of creating a Company community in the immediate vicinity of the buildings. Murray Hill is about twenty-five miles from the New York headquarters.

The executive offices of Bell Telephone Laboratories will continue to be at 463 West Street, New York City, and a majority of the employees will continue to work there. With the addition at Murray Hill, however, about two thousand employees will work at the new site compared with more than one thousand employed there during the War. This will include all the research work, and most of the work of apparatus development.

Though designed for peace-time use, the present new laboratory opened just as the United States was entering the War, and its new and adaptable space proved to be a great aid to Bell Laboratories' war service. Within its walls scores of war projects have been started, some small and completed quickly, others large and expanding from a room to whole sections of the building. The completion of the Murray Hill building project will find Bell Telephone Laboratories well equipped to design better and more economical telephone and radio equipment for the Bell Telephone System. It will also be ready and equipped to continue its record of achievement in developments for the U.S. Army and Navy as they may have need for its services in the future.

FORTHCOMING EVENTS

Saturday, September 1—Sunday, September 2

Scientific Film Association (at the Technical College, Huddersfield).—Conference on "The Film in Science".

Saturday, September 1

At 9.45 a.m.—Mr. W. F. Andrews: "The Film in Industry", 1: "Scientific Film Needs in Technical Training"; Mr. H. Richmond: "The Film in Industry", 2: "Film Strip in Technical Training"; at 2 p.m.—Mr. Derek Stewart: "The Film as an Instrument of Scientific Research"; at 7.30 p.m.—Mr. Frank Goodliffe: "Film Production".

Sunday, September 2

At 10.30 a.m.—"The Film in Medicine" (Film Show and Discussion); at 2.15 p.m.—Dr. W. T. Astbury, F.R.S.: "X-Ray Adventures among the Proteins and other Molecular Giants"; at 7.30 p.m.—Programme of New Scientific Films.

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Mechanical Engineers for Oil Refineries (Ref. No. C. 2587.XA), Senior Research Engineers (Ref. No. C. 2622.XA), and Senior Mechanical Engineers for direction of work on the application of Fuels and Lubricants to I.C. and other Engines and to various types of Industrial Work (Ref. No. C. 2667.XA), for home and overseas service with large Industrial Organization—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting the appropriate Ref. No. (September 7).

Assistant (temporary) to the Chief Engineer—The Clerk to the Committee, County Mental Hospital, Winwick, Warrington (September 8).

Engineering Assistant—The Engineer, Portsmouth Water Company, 26 Commercial Road, Portsmouth (September 8).

Assistant in Zoology—The Secretary, The University, Aberdeen (September 10).

Women Education Officers (temporary) for Nigeria: (*a*) Four Graduates in Science (Physics, Chemistry or Biology) for Junior Classes in Secondary Schools, (*b*) Two Fully Qualified Domestic Science Specialists for administrative, inspecting, and some teaching duties—The Secretary (IER: CA), Ministry of Education, Belgrave Square, London, S.W.1, or The Secretary, Scottish Education Department, 10 Abercromby Place, Edinburgh, 3 (September 10).

First Civil Engineering Assistant in the County Water Engineer's Department—The County Clerk, Lanarkshire House, 191 Ingram Street, Glasgow, C.1 (September 14).

Lecturer in Chemistry at Gordon Memorial College, Khartoum—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting Ref. No. F. 4717.A (September 15).

Organic Chemist at Long Ashton Research Station—The Secretary and Registrar, The University, Bristol 8 (September 15).

Research Physicist (preferably with experimental knowledge of electric circuits), and a Biologist, to establish and work in a suitably equipped laboratory in London to study and develop sensory devices for the blind under the general guidance of its newly appointed Sensory Devices Committee—The Secretary, St. Dunstan's, 9 Park Crescent, London, W.1 (September 15).

Chair of Philosophy—The Dean, Faculty of Arts, Fouad I University, Cairo, Egypt (September 15).

Assistant in Mathematics—The Secretary, The University, Aberdeen (September 15).

Lecturer in Production Engineering to teach Workshop Technology to the standard of Higher National Certificate in Production Engineering in the Denbighshire Technical College—The Director of Education, Education Offices, Ruthin (September 15).

Head of the Department of Horticulture—The Secretary, West of Scotland Agricultural College, 6 Blythswood Square, Glasgow (September 15).

Professor of Veterinary Surgery, Obstetrics and Animal Husbandry at the Veterinary College, Ballsbridge, Dublin—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (September 28).

Assistant Lecturer or Lecturer in (*a*) Philosophy, (*b*) Mathematics (Applied Mathematics: special qualifications in Atomic Physics essential), (*c*) Engineering, (*d*) Mining (with special qualifications in Coal Preparation)—The Registrar, University College of South Wales, Cathays Park, Cardiff (September 29).

Lecturer in the Department of Mathematics—The Secretary, Queen's University, Belfast (September 30).

Lecturer (Grade III) in the Department of Pure Mathematics—The Registrar, The University, Liverpool (September 30).

Mining Consultant to advise the Government of Tanganyika on all matters pertaining to mining development in that Territory—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting C.2738.A (October 1).

County Analyst and Official Agricultural Analyst—The Clerk to the County Council, County Hall, Maidstone (October 6).

Lecturer in Psychology in the Natal University College, Pietermaritzburg—The Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1 (October 7).

Regius Chair of Natural History at Aberdeen University—The Private Secretary, Scottish Office, Fielden House, 10 Great College Street, London, S.W.1 (October 15).

Sir Dorabji Tata Reader in Pharmaceutical Chemistry—The Registrar, The University, Bombay, India (October 15).

Director of the College—The Secretary, Royal Technical College, Glasgow (October 20).

Chemist and Bacteriologist to the Barnsley Waterworks Department—The Waterworks Engineer and Manager, Town Hall, Barnsley, Yorks (October 30).

Deputy County Surveyor and Engineer—The Clerk to the County Council, County Hall, Wakefield, Yorks (October 31).

Instrument Makers, experienced, used to high-class Experimental Work, for the Royal Aircraft Establishment, Farnborough, Hants—The Exchange Manager, Ministry of Labour and National Service, High Street, Aldershot.

Experimental Engineer with marked ability in design and development of instrument mechanisms, by a Mechanical and Electrical Instruments Manufacturing Company in East Anglia—The Ministry of Labour and National Service, Appointments Office, Lloyds Bank Chambers, Hobson Street, Cambridge, quoting Ref. No. 216.

Director of the Scientific Instrument Manufacturers' Association of Great Britain—The Secretaries, Messrs. Binder, Hamlyn and Co., River Plate House, 12-13 South Place, London, E.C.2.

Chemist, with good general knowledge, capable of undertaking investigation of methods for handling and processing palm oil, fruit juices and other food products, for British West Africa—The Ministry of Labour and National Service, Appointments Department, Sardinia Street, Kingsway, London, W.C.2, quoting Ref. No. O.S. 1034.

Mechanical or Civil Engineers for Middle East to take charge of sections of extensive construction and erection contract (must have experience of construction of large process plants, oil refineries, or similar works)—The Ministry of Labour and National Service, Appointments Department, Sardinia Street, Kingsway, London, W.C.2, quoting No. O.S. 1050.

Assistant Tutor in Mathematics—The Secretary, University of London Institute of Education, 42 Portman Square, London, W.1.

Inspectors of Cotton Cultivation in the Sudan—The Ministry of Labour and National Service, Appointments Department, Sardinia Street, Kingsway, London, W.C.2, quoting Ref. No. O.S. 1028.

County Horticultural Secretary—The County Secretary, N.F.U., Farmers' Club, Worcester.

Assistant Teacher of Civil Engineering and associated Subjects—The Principal, Birmingham Central Technical College, Birmingham, 1.

Lecturer (full-time) in Metallurgy—The Principal, Borough Polytechnic, Borough Road, London, S.E.1.

Lecturer in Geography, qualified to undertake work to Degree standard—The Registrar, Municipal College, Portsmouth.

Lecturer in Electrical Engineering (should possess an Honours Degree or equivalent qualification in Electrical Engineering or Physics, with Radio), a Lecturer in Electrical Technology and Maintenance (should possess a Degree or equivalent qualification in Electrical Engineering), and an Instrument Mechanic, in the Rotherham College of Technology—The Director of Education, Education Offices, Rotherham.

Lecturer (graduate) in the Metallurgy Department, and an Assistant Lecturer in Engineering for Workshop Technology and Practice, in the Swansea Technical College—The Director of Education, Guildhall, Swansea.

Engineering Workshop Instructor and Steward in the Batley Technical College and School of Art—The Education Officer, Education Offices, Batley, Yorks.

Lecturer (man or woman) in Mathematics and Physics—The Principal, Training College, Castle View, Dudley.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

National Trust for Places of Historic Interest or Natural Beauty. Report 1944–45. Pp. 112+4 plates. (London: National Trust, 1945.) [18

The West Indies and the Mountain Uplift Problem. By Dr. C. T. Trechmann. Pp. 26. (Castle Eden: The Author, 1945.) [18

Scottish Marine Biological Association. Annual Report, 1938–39. Pp. 48. Annual Report, 1939–40. Pp. 32. Annual Report, 1940–41. Pp. 32. Annual Report, 1941–42. Pp. 20. Annual Report, 1942–43. Pp. 24. Annual Report, 1943–44. Pp. 24. (Millport: Scottish Marine Biological Association, 1940–1945.) [18

Other Countries

Transactions of the American Philosophical Society. New Series, Vol. 34, Part 3: The Mammalia of the Duchesne River Oligocene. By Prof. William B. Scott. Pp. 209–254+8 plates. (Philadelphia: American Philosophical Society, 1945.) 2.25 dollars. [197

Annual Report of the Research Council of Alberta, 1943. (Report No. 44.) Pp. 14. (Edmonton, Alba.: King's Printer, 1945.) 5 cents. [237

Research Council of Alberta. Contribution 4: Hot-Water Separation of Alberta Bituminous Sand. By K. A. Clark. Pp. 18. Contribution 5: Some Physical Properties of a Sample of Alberta Bituminous Sand. By K. A. Clark. Pp. 8. (Edmonton, Alba.: King's Printer, 1944.) [237

Department of Scientific and Industrial Research, New Zealand. Bulletin No. 87: Eighth Annual Report, for the Year 1940–41, of the Wheat Research Institute, Christchurch, New Zealand. Pp. 24. 1*s*. Bulletin No. 88: Fireclay and Ganister in New Zealand. By J. Henderson. Pp. 40. 2*s*. 6*d*. Bulletin No. 89: The Dairy Industry in New Zealand. By W. M. Hamilton. Pp. 176. 7*s*. 6*d*. Bulletin No. 90: Milburn-Clarendon Phosphate Deposits. By E. O. Macpherson. Pp. 44+7 plates. 2*s*. 6*d*. Bulletin No. 91: Nassella Tussock (*Nassella trichotoma* (Nees.) Hack.); Field Studies and their Agricultural Significance. By A. J. Healy. Pp. 90+6 plates. 2*s*. 9*d*. (Wellington: Government Printer, 1942–1945.) [237

NATURE

No. 3958 SATURDAY, SEPTEMBER 8, 1945 Vol. 156

CONTENTS

Page
Natural History Museums and Research . . . 277
Method in Social Studies. By Prof. David Mitrany . 278
Morbid Histology of the Eye 279
Social Psychiatry. By Dr. J. Leycester King . . . 279
Experiences of a Woman Farmer. By Sir John Russell, F.R.S. 280
Science in the U.S.S.R.
  Geology and Palæobotany. By W. N. Edwards . 282
  Physical Chemistry. By Prof. C. N. Hinshelwood, F.R.S. 283
  Surface Chemistry. By Prof. N. K. Adam, F.R.S. . 284
Post-War Forest Policy in India. By Prof. E. P. Stebbing 286
Nutrition in Jamaica 288
Obituaries :
  Dr. Gustav Senn. By Sir D'Arcy Thompson, C.B., F.R.S. 289
  Prebendary Lonsdale Ragg. By Sir Geoffrey Evans, C.I.E. 289
  Sir William H. Ellis, G.B.E. By J. F. Bridge. . 290
News and Views 290
Letters to the Editors :
  Phosphatase on Chromosomes.—Dr. J. F. Danielli and D. G. Catcheside 294
  Pigments and Chromatophore Reactions of *Polycelis nigra* and *Planaria lugubris*.—Capt. J. L. Cloudsley-Thompson 294
  Production of Extracellular Starch in Cultures of Capsulated Yeasts.—Dr. M. Aschner, J. Mager and Dr. J. Leibowitz 295
  Antibiotics from Moulds.—J. Kent and N. G. Heatley 295
  Glioma in a Rat Fed with 2-Acetyl-amino-fluorene.—Dr. E. Vazquez Lopez 296
  Penicillin in Kala Azar.—Dr. E. S. Horgan and Mohamed Hamed Satti 297
  A Medium for Mounting Parasitic Helminths.—Dr. Fei-pai Li and Fu-hsi Yang ; Dr. G. Lapage . 297
  Production of Skin Burns by Hot Gases.—O. M. Lidwell 298
  Absolute and Differential Light Sensitivity of the Dark-adapting Eye.—Dr. H. Pollak and D. G. Wilson 299
  Parthenocarpic Production of Tomato Fruits.—Thomas Swarbrick 300
  Neutron-Proton Scattering at 8·8 and 13 MeV.—Mario Bunge 301
  Time Dependence of Interfacial Tension and Density in Solutions.—Prof. George Antonoff . 301
  Occurrence of Boron Phosphate in Fireside Deposit from an Economizer.—L. M. Clark and J. Haslam 302
  The Hazel Period in the Post-Glacial Development of Forests.—Prof. Felix Rawitscher . . . 302
  Choline Esterases.—Dr. K.-B. Augustinsson . . 303
  A Theory of Telepathy.—A. T. Oram 303
  Custody of Uranium.—Prof. Sidney Russ, C.B.E. . 303
Research Items 304
Aspects of the Determination of the Strength of Materials 306
A 'Constitutional Synthesis of Chondrosamine. By Drs. Sybil P. James, F. Smith, M. Stacey and L. F. Wiggins 308
Iron Age Finds from Anglesey. By M. C. Burkitt . . 309

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NATURAL HISTORY MUSEUMS AND RESEARCH

IN recent discussions on the place of museums in the reconstruction of our national life, attention has, not unnaturally, been concentrated on their educational functions. Less prominence has been given to their importance as instruments of research. Nevertheless, there can be little doubt that the expenditure of public funds on museums is justified as much by their contributions to the advancement of knowledge as by their services in the diffusion of information. This is conspicuously the case with the great national museums concerned with the various branches of natural history, where the specimens exhibited in public galleries are only a small fraction of the material available. The vast collections accumulated in the natural history departments of the British Museum at South Kensington, for example, or the great herbaria at Kew and Edinburgh, are of little significance from the point of view of popular education ; yet they furnish an indispensable basis, without which all work on biological systematics in Great Britain would be gravely impeded if it did not become impossible.

It is unfortunately true that the fundamental importance of taxonomy (or systematics) is not fully realized by all biologists. At many British universities the courses of teaching in zoology and botany deal with the classification of animals and plants in a very summary and inadequate fashion, while the methods and conventions of systematics are altogether neglected. It is not uncommon to meet with young professional biologists engaged in teaching or research who have only the most hazy ideas on how to set about the identification of an unknown animal or plant, and who would be completely at a loss if required to draw up a description of a new species. On the other hand, the increasing attention now given to the bearings of biology on practical affairs is leading to a general appreciation of the need for precise determination of the systematic units concerned, and to constant appeals to systematists for help in making these determinations.

It may not be inopportune, therefore, to recapitulate some elementary considerations regarding the functions of museum collections in the service of systematic zoology and botany. These considerations are very familiar to all systematists, but are too often forgotten or misunderstood by those whose work lies in other fields of biological research.

In the first place, museums are essential as depositories for the preservation of type-specimens, that is to say, the original specimens on which descriptions of new species (or lesser systematic units) have been based. No matter how carefully such descriptions may have been drawn up, the advance of knowledge will sooner or later render them inadequate, and the definitive identification of the species can only be settled by a re-examination of the type-specimens. In our everyday measurements of weights and distances, we no longer appeal to comparisons with natural objects—the weight of a grain of corn, for example, or the measure of a quadrant of the earth's meridian—but to standard weights and measuring-rods preserved in the custody of government institutions. Similarly, the type-specimens are the final standards to which, in subsequent changes of nomenclature, the systematic names must adhere, and by reference to which in cases of dispute the original diagnoses must be expanded and amended.

This leads to another point of importance in the functions of natural history museums. The type-specimens contained in any of the national museums form only a small proportion of the collections stored in them. For example, in the natural history departments of the British Museum the total number of specimens is counted in millions, but the type-specimens cannot amount to more than a few thousands. The question is sometimes asked: "What is the use of amassing and constantly adding to these vast collections?" The answer to this is twofold.

In the first place, no matter how finely we may subdivide our systematic units—species, subspecies, varieties, forms, phases and so forth—the narrowest category will always include some range of variability. No individual animal or plant is ever completely and in all respects identical with any other. To define the limits of this variation, to discover its laws and to explore its correlations, long series of specimens are required, such as are only to be found in the larger museums, and it is there alone that such studies can be profitably pursued.

In the second place, the discovery of new forms, whether of specific or infra-specific categories, sooner or later necessitates a re-examination of the characters of the related forms already known. Every systematist knows that new species are constantly being discovered which differ from their nearest allies in respect of characters which previous workers have not thought it necessary to take into account. When this happens, a revision of the whole group, be it species or genus or family, must be undertaken. This revision and re-ordering of the forms that are supposed to be already 'known' is the most urgent task confronting systematists, and it is one that can only be profitably approached with the help of the large museums.

To sum up, a precise and detailed taxonomy is an indispensable foundation of all biological research; instruction in the elements of taxonomic practice should form part of the training of all biologists; the custody of the standards of this taxonomy is as much the business of the State as the custody of the standards of weights and measures; the maintenance of large collections carefully preserved and arranged and accessible to all qualified workers is essential if the study of taxonomy is to keep pace with the increasing demands made upon it by workers in other fields of biological science, both 'pure' and 'applied'. No one, nowadays, is likely to question the immense part which museums have to play in popular education or to grudge the expenditure of public funds required if they are adequately to discharge this function. At the same time, however, it is to be urged that the importance of the 'study collections' in the national museums for the future development of biology in Great Britain should not be lost sight of, and that the relatively small expenditure required for their accommodation, staffing and continued development should be given a high priority in the national provision for the support of scientific research.

METHOD IN SOCIAL STUDIES

Methodology of the Social Sciences

By Prof. Felix Kaufmann. Pp. ix+272. (London, New York and Toronto: Oxford University Press, 1944.) 20*s*. net.

PROF. F. KAUFMANN, formerly of Vienna and now at the New School of Social Research in New York, has long been concerned with problems of methodology. Here he attacks the most difficult of them, the methodology of the social sciences, though only in the second and shorter half of the book. In the first half he surveys the general problems of scientific method, because of his belief that its chief issues are broadly identical in the natural and the social sciences, the difference between them being merely one of degree. In the contrast between deductive reasoning and empirical procedure, around which he weaves his main argument, the author sees the key to "the solution of many apparently unrelated problems in natural and social science".

The book covers a great deal of ground, much of it familiar, and inevitably the argument is very condensed. Its central purpose is to demonstrate the meaning of methodology as an "autonomous discipline", the author having described in an earlier contribution its task as that of making explicit—"to collect, systematise and justify"—the general assumptions which in making empirical statements the man of science takes for granted. In the present work Prof. Kaufmann amplifies that statement and says that the task is to make explicit the theoretical laws implicit in social science and their interrelation with one another and with physical laws. Perhaps his position can be indicated most fairly by giving two central points in his own words: "Most methodological issues in social science are directly or indirectly concerned with some aspects of the relations between natural science and social science, particularly the extent to which the methods of the former are appropriate to the latter". But the "comparison of physical laws and social laws has been misled by erroneous preconceptions concerning the nature of the former. Physical laws have been contrasted as necessary or strict laws with mere rules or tendencies prevailing in the social field. But as soon as it is realized, first, that no synthetic proposition is necessarily valid, and, secondly, that many physical laws, among them the most general laws, are not strict (empirical) laws either, this contrast is seen to be of no fundamental methodological significance". Elsewhere the author grants that social laws are "less precise" than physical laws, but insists that the difference is one of degree, and that many "rather precise" predictions of events can be made in the social world.

This is a painstaking study, and the author's views are generally stated with moderation, but many of them are debatable. Perhaps three general criticisms may be more to the point. (1) The argument is not helped in a book which is meant to be an essay in clarification by the use of terms which are clumsy and obscure, such as 'introspectionism', 'dimensions of relationality', and so on. This is made worse by inadequate editing, which has often allowed a wrong use of ordinary words, such as 'confounded' for 'confused', etc. (2) The author endeavours to reduce the logical gap between methods in natural and social science, and generally his formal argument is plausible enough; but at times he strains it beyond the point where it could stand up to his own tests. That is often evident in his concrete illustrations. "Rather precise" is scarcely scientific, all the less so when to show the possibility of social prediction one has to come down to so naive a level in the scale of proof as to say that "we have a rather definite idea about what will happen to a letter that we mail or to a railway train for which we have purchased a ticket"; or has to reach out beyond any legitimate range so as to claim that the biological side of man is part of social science. (3) The whole elaborate argument does not in the end get beyond the old and hard problem, with its two distinct aspects. One is the logical use of the intellectual instrument, whichever the discipline; the other is the application of the knowledge thus acquired to the building up of generally valid propositions. Here we are faced with the awkward experience that the more systematic a social discipline or school has tried to be, by the somewhat forced use of exact methods, the more dogmatic have tended to be its conclusions, so that often method became identified with doctrine. The author mentions how the controversy about scientific method between the behaviourist and the psycho-analytical schools of psychology clearly showed that each party really wanted to justify not a general method but its particular theory.

Prof. Kaufmann himself says that in this field scientific results must be judged in the light of their success. The social sciences have been much favoured in England, yet the great scholars who have pioneered and led in this field have spent little time on discussions of methodology as such. The interest in methodology has been greater among French scholars, whose logical bent inclined them to seek for universal formal laws, and especially among German scholars, always in search of some metaphysical system; and more recently in America, where bent and facilities have led to heavy labours in the statistical field. In a sense, that intense specialization in the pursuit of the 'scientific' has delayed the synthesis which alone could illuminate the heart of the social problem. Social causation is a matter of an eternally varying interrelation of things; and understanding will come to us not through any set general method, but, as hitherto, through the sensible appraisal at any given time of the several sides of man's life in society.

DAVID MITRANY.

MORBID HISTOLOGY OF THE EYE

A Pathology of the Eye

By Eugene Wolff. Second edition. Pp. vii+285. (London: H. K. Lewis and Co., Ltd., 1944.) 42*s*. net.

THE study of ocular pathology occupies a somewhat anomalous position in general pathology. In contrast to the extensive knowledge on the comparative anatomy of the eye, there is little systematized information on comparative pathology. In human pathology, the position of this specialized study is likewise unsatisfactory. Clinical ophthalmology is probably the most exact of the medical disciplines, for the diseases of the interior of the eye are almost as readily amenable to direct inspection as those of the outer eye. The wealth of biomicroscopic and fundus studies is, however, poorly supported by histological findings. Eye disease rarely leads to death, so that the special eye institutions have only very occasional opportunities of post-mortem examination, while such eyes as are removed in life generally show extensive secondary complications which have led to the removal of the eye; the primary processes themselves are not often seen under the microscope.

For these and other reasons the literature on ocular pathology is sparse and contradictory. If, in addition, ocular pathology is taken in a wider sense to include the mechanism of the disease-processes of the eye, and not merely anatomical end results, an unsatisfactory state of affairs almost reaches exasperation. Any attempt at a systematization of ophthalmic pathology must therefore be regarded with gratitude by the reader and as a Sysiphean task by the author. There are few such studies in English; that by Collins and Mayou represented the most ambitious attempt, both in scope and in its search for an etiological basis for a mass of disconnected histological features. Its obsolete histological interpretations, and its somewhat forced classification, make that book no longer serviceable. Mr. Eugene Wolff brought out a less ambitious attempt some five or six years ago. His "Pathology of the Eye" was essentially an account of what is known of the morbid histology of the common clinical conditions. Its excellent illustrations supplemented a rather elementary text, but the whole constituted an adequate text-book on the morbid anatomy of the eye. It has filled a gap for the student and practitioner, and the second edition shows considerable expansion. The author has wisely curtailed much redundant clinical information that appeared in the first edition, thus making room for further details on morbid histology. There is, however, little in this volume on the wider aspects of pathology as distinct from morbid histology.

In spite of war conditions the high standard of production noticeable in the first edition has been maintained.

SOCIAL PSYCHIATRY

Man and his Fellowmen

Modern Chapters on Social Psychology. By Dr. Samuel Lowy. Pp. xiv+194. (London: Kegan Paul and Co., Ltd., 1944.) 15*s*. net.

THE author of this book is quite evidently better equipped for discerning the social-psychological problems of our times than he is for elaborating the solutions to those problems. Indeed, his suggested solutions, apart from certain valuable exceptions, are inspired by a pathetically child-like confidence in the omnicompetence of the State. He offers no grounds to support his implied contention that the State itself is immune from those psychological ills from which the people as a whole are suffering.

No one should, however, be deterred by this criticism from buying and reading the book. In such a complex field, to point out the problems accurately, and to lay down the solutions unerringly, would call for a superman, and such a stature Dr. Lowy would be the last to claim. But he has certainly produced a valuable, readable and acute discussion, covering a very wide range of topics, of the psychological factors which lie at the root of the troubles which disorganize, disintegrate and devitalize the social body. Though I have several reservations regarding the author's proposed remedies in detail, yet I emphatically agree with him that many of these troubles are remediable and, in principle, easily remediable. We are to-day needlessly squandering a vast amount of human spiritual energy, and the social psychologist can point the way to greatly enhanced human happiness, both for the individual and for the social group.

No one with knowledge of the facts will be likely to challenge the statement that the volume of psychological disability to-day is vastly in excess of the facilities which exist for dealing with it. Even in the mental hospitals, only a small proportion of patients suitable for psychological treatment can in fact receive such treatment. Non-institutionalized sufferers form a far larger proportion of the general population than is commonly suspected—indeed the proportion is so high that adequate therapeutic provision for them is beyond the realm of practical possibility. Prevention is always better than cure, but where the evil is widespread and increasing and cure is impossible, prevention becomes simply imperative. Dr. Lowy makes a very comprehensive survey of the field in which such preventive psychiatry should operate, and one can easily agree with him that this work is unlikely to be undertaken to an adequate extent without considerable encouragement and initiative on the part of the State. Perhaps the most immediate need is that for greatly increased popular enlightenment on the subject. This need not involve the danger, no doubt anticipated by some, that an increased interest in psychological aberrations will itself breed such aberrations, for there is a large accumulation of sober, simple, unsensational and scientifically authenticated facts which clamour for immediate application to the important business of living together efficiently and happily. There are encouraging signs of a growing demand for such popular psychological enlightenment, and it is important that this demand should be met by a form of instruction well conceived both as to method and to content.

A further edition of this book, which we may confidently expect, will provide an opportunity for the weeding out of several teutonisms which have escaped the reviser's eye. J. LEYCESTER KING.

EXPERIENCES OF A WOMAN FARMER

Four Years Harvest

By Frances Donaldson. Pp. 115+16 plates. (London : Faber and Faber, Ltd., 1945.) 7*s*. 6*d*. net.

SOME four years ago Mrs. Donaldson, tiring of town life, started farming. She had neither previous experience nor close association with the land; all the preparation she allowed herself was a six months course at the Moulton Agricultural Institute, Northampton. She did not even give herself the twelve months apprenticeship on somebody else's farm, usually recommended as the least costly way of gaining experience; she straightway purchased and stocked a Midland clay farm of 375 acres. At the end of the first year she wrote a book, "Approach to Farming", describing her experiences as a beginner; she also gave some talks for the B.B.C. and had some very direct things to say about the process and the announcers which a man would either not have noticed or not have mentioned. That part of her work was clearly successful, and her farming was satisfying enough to induce her to continue; now at the end of the fourth season she gives us another book in which she sets out quite frankly both her successes and her failures.

The human aspects of farming loom far more largely in the book than the technical problems, and Mrs. Donaldson not only knows her mind but also has a vivid way of expressing it. She was not at all impressed by the 'technicians': "I think there is no one so smug, so unreasonably conceited, so bigoted and so invulnerable . . . in order to strengthen his self-importance he is driven to obscure, to render exclusive and immeasurably difficult that which he knows". Nor are officials more pleasing in her sight, with one single exception who, "curiously enough, was a man of distinction, personality and brains". The filling up of forms, which under the present system of controls in Britain has become almost a new industry, invokes some scathing comment: "there is something peculiarly nasty about form filling. If you wish to apply for a few yards of piping to lay some water on to a field you have to fill in the same form as you would use if you wished to build a £100,000 factory". Yet at the end of the book Mrs. Donaldson advocates nationalization and more form filling, more control, which of course would mean more officials. If all this came about we should await with interest another book from Mrs. Donaldson setting out her further experiences with the very considerable clarity she commands.

The reader will have judged that the author is a lady of marked personality and will readily understand that, having selected a farm staff that she liked, found some good farming friends to advise her, and arrived at a system of farming that she liked, she is making a success of it. This is all to the good, for there is no doubt that an infusion of women into the agricultural community would strengthen it. For many years now there have been successful women farmers; but it is only in recent times that the general public has known much about them. But it should not be inferred from Mrs. Donaldson's book that farming can be successfully tackled by any woman after only six months training. She has been fortunate in her time of starting: it has been a period of rising prices and of considerable willingness on the part of members of the agricultural community to help each other, while the War Agricultural Committees have been in a position to undertake work requiring big implements such as combines and dryers, the advantage of which Mrs. Donaldson gracefully acknowledges. There was a similar favourable period in the War of 1914–18 and for a time afterwards. But then came the slump. Whether that will happen again no one can tell. Meanwhile any woman who thinks of taking up farming would do well to read Mrs. Donaldson's experiences, for she will learn from them about the wide range of difficulties, technical and human, with which she will be confronted, and of the ways in which they were overcome. E. JOHN RUSSELL.

Society of Chemical Industry

Annual Reports on the Progress of Applied Chemistry. Vol. 28, 1943. Pp. 517. (London: Society of Chemical Industry, 1944.) 20*s.*

THIS volume surveys progress under the following principal headings: chemical engineering, plant and machinery; fuel; gas, destructive distillation, tar, and tar products; mineral oils; intermediates and colouring matters; fibres, textiles, and cellulose; pulp and paper; acids, alkalis, salts, etc.; glass; ceramics, refractories, and cements; iron and steel; non-ferrous metals; electrochemical and electrometallurgical industries; fats, fatty oils, and detergents; plastics; resins, drying oils, varnishes, and paints; rubber; leather; soils and fertilizers; sugars and starches; the fermentation industries; foods; fine chemicals and medicinal substances; photographic materials and process; sanitation and water purification. F. Rumford concludes that the study of chemical plant design is being neglected, or at least under-publicized, in Great Britain. W. W. Goulston refers to the influence of the cargo aeroplane and the application of jet propulsion on the future production programme of the petroleum industry. J. Grant welcomes plans for the formation of a research association for the paper-making industry. P. Parrish and F. C. Snelling anticipate a large post-'armistice' demand for fertilizers and remark on the enthusiastic reception in Britain of National Growmore fertilizer. J. Woolman records the use of the electron microscope for investigating the structure of steel. J. Hofton points out that security needs may have given the impression that Great Britain is 'tailing along' behind the United States in developing the plastics industry. T. R. Dawson states that the search for rubber-bearing plants has added little to the prospect of supplies. B. M. Brown mentions the substitution by British brewers of part of the barley malt by unmalted oat flakes. N. Evers emphasizes the importance of recent expansion in the production of mepacrine (the substitute for quinine) and penicillin.

Science and the Idea of God

By William Ernest Hocking. (John Calvin McNair Lectures.) Pp. xi+124. (Chapel Hill, N.C.: University of North Carolina Press; London: Oxford University Press, 1944.) 9*s.* 6*d.* net.

IN *Nature* of May 1, 1943, there appeared a survey of an American manifesto on Education for Citizenship, in the course of which special attention was directed to the contribution of Prof. W. E. Hocking of Harvard. The theme of his choice was the role of philosophy in that branch of education. This seemed an odd choice until he made it clear that he regarded philosophy, not as a luxury subject with no bearing on the daily bread of education, but as the sum of men's working beliefs, implicit in "every editorial, every play, every sermon, every novel, almost every conversation". He united learned acquaintance with the great philosophers and determination to see things with his own eyes, and he struck out his own line.

Prof. Hocking's latest book takes us back at once to the "conflict between religion and science" which waged last century. The conflict seems to have subsided on terms of mutual toleration. The scientific man is apt to get on with his job on the understanding that God never interferes. Religion replies that this is "equivalent to tolerating a dead God": Prof. Hocking sharpens this issue by putting it in the form of a dilemma: (1) God must not interfere in scientific business; (2) God cannot be an inactive cipher in human affairs. He then takes the reader through a closely knit argument, designed to show that science and religion, though sharpening and then solving their contemporary dilemmas, are "brought into a fertile union in which the idea of God is enriched". The book is not, and could not be, easy reading; but it will make a stirring appeal to many a man of science.

Politics and Morals

By Benedetto Croce. Translated from the Italian by Salvatore J. Castiglione. Pp. v+204. (New York: Philosophical Library, Inc., 1945.) 3 dollars.

FROM the bibliography of Croce by Castellano (1936) it may be inferred that most of the essays here translated appeared in 1925 ("Elementi di Politica"), but that some of those added to the 1931 volume ("Etica e Politica") are included. Translator and publisher omit this and all other information.

Croce's writing is diffuse and his method rhetorical, but he has something valuable to say, and what he wrote after the first World War may be relevant to the aftermath of the second. History, for Croce, is a process of conflict between rival tendencies and aims in the course of which the human spirit creates itself and attains freedom. One aspect of this conflict is that between mere force or political power and moral ideals. Perhaps the most valuable point he makes is that political theories are always in the first place political programmes, and only in the second are they attempts to find a rational basis for them. Even so they generally suffer from fallacies of abstraction, imitating the abstractions of natural science without the technical justification these have in their own sphere. Recent efforts to label political theory 'sociology' do not alter the case. A. D. RITCHIE.

The Bates Method for Good Sight without Glasses

By Dr. William H. Bates. Pp. 160. (London: Faber and Faber, Ltd., 1944.) 10*s.* 6*d.* net.

THOSE who are at all interested in the subject of this book are probably very well acquainted already with Mr. Aldous Huxley's book "The Art of Seeing". One of Mr. Huxley's motives in writing that book was to repay "a debt of gratitude to the pioneer of visual education, the late Dr. W. H. Bates, and to his disciple, Mrs. M. D. Corbett", to whose skill as a teacher he owed the very heavy debt of improvement in his own vision when his case seemed hopeless. Mr. Huxley's general position, following Dr. Bates, is that the orthodox ophthalmologist has paid exclusive attention to one aspect of the complex process of seeing, the physiological, and has ignored the mind, which makes use of the eyes to see with. Unfortunately, Mr. Huxley is incapable of writing anything but a very clever book; a short and easy set of advice and suggestions would have been far more acceptable to many a reader.

The original edition of Dr. Bates' book was published more than twenty years ago. This new and revised edition omits unnecessary technical material, but includes all that is deemed necessary for a layman's use. Dr. Bates based his theory of course upon visual re-education, instead of mechanical aid in the form of glasses. The object of this brief notice is simply to pass on this information. No attempt is made to decide the issue "when doctors disagree".

SCIENCE IN THE U.S.S.R.*

GEOLOGY AND PALÆOBOTANY

By W. N. EDWARDS
British Museum (Natural History)

MUCH has already been written on the expansion of geological research and the development of mineral resources in the U.S.S.R. during the last quarter of a century, and the Seventeenth International Geological Congress held in Moscow in 1937 provided an opportunity for viewing some aspects of that work in the field and in the laboratory, while the sessions and the publications of the Congress summarized achievements to that date. In June of the present year some British geologists were invited to resume personal contact with Russian colleagues, and to learn something of their recent progress on the occasion of the 220th jubilee celebrations arranged by the Academy of Sciences of the U.S.S.R., only a few weeks after the cessation of hostilities in Europe.

Although activities during the past few years have been dominated by the necessity for prospecting for new deposits of various strategic minerals and for further developing previously known deposits, a great deal of incidental stratigraphical, palæontological and tectonic work has been accomplished. The end of the War therefore brings a rich harvest of important monographs and maps awaiting publication, while the release from the urgent necessity of dealing with practical demands means that now, as the veteran Academician V. A. Obruchev said at Moscow, "it is the theoretical problems that claim our closest attention".

The geological map of the whole of the Soviet Union on the scale of 1 : 5,000,000, edited by D. V. Nalivkin and published in 1937, was partly based on a series of regional manuscript maps on larger scales, and many of these maps have since been published. The Central Geological Prospecting Institute, directed by I. I. Gorsky, is now in process of issuing the sheets of a map again planned to cover the whole of the U.S.S.R., this time on a scale 1 : 1,000,000 ; European Russia is already completed, as well as considerable areas of central Asia. A new map of the Urals (in preparation) will endeavour to show stratigraphy, tectonics, useful minerals, drift and lithology on the same map. The only regions where geological surveying has not been carried out in any detail are certain areas of north-east Siberia, where the frozen terrain is exceedingly difficult; these regions will probably be left until last in the programme for mapping geologically the whole of the U.S.S.R., but are by no means being neglected in the meantime, for a special Institute for the Study of Permanently Frozen Ground has been set up by the Academy of Sciences under the direction of V. A. Obruchev, with headquarters in Moscow and field stations at Igarka and Yakutsk.

Among publications of the past decade, pride of place should be given to the several different series of volumes planned to cover all aspects of geological science for the whole of the Soviet Union. "The Geology of the U.S.S.R.", edited by J. S. Edelstein, is arranged on a regional basis and will extend to twenty-seven volumes, of which six have appeared so far, on the Urals, Donetz Basin, Kuznetzk Basin, Transcaucasia (two) and Eastern Kazakstan. "The Stratigraphy of the U.S.S.R.", of which volume 1 on the Pre-Cambrian appeared in 1939, will be completed in fifteen volumes. In addition to "The Palæontology of the U.S.S.R." and the "Monographs of Palæontology", there is an "Atlas of the Leading Forms of the Fossil Faunas of the U.S.S.R.", of which some four or five volumes have appeared and another half-dozen are ready for publication. There are also series on the "Minerals", the "Petrography", the "Pegmatites", and the "Soils of the U.S.S.R.", "The Mineralogy of the Urals", and Obruchev's "Geology of Siberia" in three volumes. Six volumes of the Proceedings of the Seventeenth International Geological Congress were issued in 1939 and 1940.

Soviet geology has suffered the loss by death of three of its most distinguished leaders during the last year : A. A. Borissiak (1872–1944), who after an early career in stratigraphy and tectonics became the leading vertebrate palæontologist in the country, V. I. Vernadsky, the veteran mineralogist (see *Nature*, March 10, 1945), and A. E. Fersman (see *Nature*, July 7).

In palæobotany, much important work has been done recently on the floras of successive horizons in the upper Carboniferous and Permian of the Asiatic parts of the Soviet Union. A question which has interested palæobotanists for nearly half a century is the supposed occurrence of elements of the southern hemisphere *Glossopteris* flora in Siberia. *Glossopteris* itself was first reported, but not figured, by Amalitzky, who was not a botanist. Since then a number of other *Glossopteris*- and *Gangamopteris*-like forms have been described by Zalessky and others; but many palæobotanists outside the U.S.S.R. have long felt dubious about the value of these records. The whole problem still awaits detailed examination, but recent and still largely unpublished work by Maria Neuburg, who kindly showed me some of the material on which her conclusions were based, proves that some at least of the supposed glossopterids are absolutely distinct.

A promising discovery of a rich upper Triassic deposit of plants with well-preserved cuticles has been announced by Prinada, and S. N. Naumóva has ready for publication an extensive monograph on the spore- and pollen-content of strata of various geological horizons. The detailed description of Upper Cretaceous and Tertiary fossil plant assemblages and the delimitation of past floral provinces is being continued by A. N. Kryshtofovich and others. Kryshtofovich has recently published, as one of the volumes in the "Palæontology of the U.S.S.R.", a complete index of the fossil flora, which includes every reference to fossil plants of all ages from all parts of the Soviet Union ; with the vast increase in the literature of the subject such works are absolutely indispensable.

Two very able young palæobotanists lost their lives on active service during the War : K. K. Shaparenko, who had written on *Ginkgo* and on *Liriodendron*, and A. V. Yarmolenko, noted for his work on upper Cretaceous plants and particularly on fossil woods.

The flexibility in the organization of scientific research in the Soviet Union, leading frequently to the combination of previously separate bodies or journals,

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* Continued from page 259.

and the habit of changing the names of institutions, is apt to be confusing to outsiders. The Academy of Sciences presented all those who attended the Jubilee Celebrations with a finely produced volume of more than three hundred pages which describes in detail all the sections and institutes of the Academy itself; this is a most useful and up-to-date work of reference but is not, of course, all-embracing. The compilation of a directory of all scientific institutions, giving not only their present but also their previous names, addresses, functions and publications, would be an inestimable boon.

PHYSICAL CHEMISTRY

By PROF. C. N. HINSHELWOOD, F.R.S.
University of Oxford

A VISIT to the scientific institutes of Moscow and Leningrad leaves one with several vivid impressions. Perhaps the strongest is that of a numerous and enthusiastic community of scientific workers, led by the most eminent scholars of the country, housed in excellent buildings, well equipped with all the facilities necessary for their work, and enjoying a nation-wide prestige which must be almost unprecedented in the history of learning.

The institutes have passed through a period of great difficulty, having been uprooted by war and evacuated to other parts of the country: as one of the directors remarked, "Two evacuations are about the equivalent of one earthquake". Nevertheless, the return to normality has gone on with remarkable speed: and new institutes seem to arise in the course of a few months. On the outskirts of Moscow, overlooking the river, and adjoining what will presently be a splendid park, stand the laboratories of Academician Kapitza and of Academician Semenov. The latter laboratory has been converted from a very fine old house and has been entirely refitted in a very short space of time to accommodate work which is now being permanently transferred from Leningrad to Moscow. The appreciation of the fact that scientific work flourishes best in serene and agreeable surroundings seems to be general. The psychology is sound, and we must hope that a similar understanding will be shown by those responsible for establishing new research centres in Britain.

It was also interesting to observe that, despite the exigencies of war, there had been a general realization of the importance of maintaining long-range fundamental research; indeed, while admiring the breadth of view which seemed to have been shown by those directing the general policy, one wondered a little uneasily whether too much of the future in our own country might not have been sacrificed to immediate needs.

Various members of the Academy of Sciences discussed quite frankly with their visitors certain aspects of their present arrangements which they have found not quite satisfactory and which they are in process of modifying. There is, for example, a feeling that in the past the organization of the work in laboratories was rather too centralized, and that for the best results rather more decentralization is beneficial. Another aspect of the same thing is that the great institutes have tended rather to overshadow the universities in research, and that the position of the latter will probably need strengthening. On the other hand, students from the universities actually do part of their work in the research institutes, so that a measure of valuable co-operation comes about. One can scarcely expect that in a vast and rapidly evolving country like the Soviet Union any of the forms of society have yet reached their stable level; but it is most gratifying to feel that in scientific matters the future seems, so far as can be judged, to be largely in the hands of the best men of science themselves.

It is only possible to mention specifically a few of the institutes and laboratories in which physico-chemical work is in progress. In Moscow there is the Institute of Academician Frumkin, which deals with problems of colloid science, taking the expression in the widest sense, which includes the study of adsorption, catalysis and electrokinetic phenomena. Beautiful experiments on the motions of charged mercury droplets in different solutions were demonstrated by Frumkin himself and discussed in a lecture during the anniversary celebrations of the Academy last June. In Moscow also are two new institutes, one presided over by P. Kapitza, known as the Institute for Physical Problems, and the other the Institute of Physical Chemistry, presided over by N. Semenov (whose name, English chemists should know, is pronounced Semyónov). The work of the former deals largely with low-temperature phenomena, and although much of it, especially the brilliant investigations on the properties of liquid helium, is of the greatest interest to physical chemists, it is perhaps best dealt with under the heading of physics. The Institute of Academician Semenov, recently transferred from Leningrad, houses a school of workers who, under the inspiration of their chief, have made one of the most characteristic of the Russian contributions to modern physical chemistry, namely, the intensive study in all their aspects of the phenomena of flame, combustion and explosions. The work of Semenov on the theory of branching reaction chains and the interpretation of explosion limits, thermal and non-thermal explosions, degenerate explosions and so on, is too well known to need description. Some of the more recent work has included ingenious studies of the way in which chemical reactions may be initiated upon a solid surface and propagate themselves into the whole volume of the material. Another development is the study of the surface electrical conductivity as a means of investigating films in which catalytic reactions occur. Much interesting work is being carried out on the part played by hydrogen atoms and hydroxyl radicals in reactions (some of this work in the Semenov Institute, some in the Frumkin Institute). It would be extremely difficult in a short account to mention individual workers; but perhaps I might remark how illuminating I found the contributions of Zeldovitch on the fascinating but extremely difficult problem of the rate of propagation of flame through combustible mixtures. This subject is of the greatest practical importance and of considerable theoretical interest, and the recent contributions maintain the traditions of the Semenov school.

It is not surprising at the present time to find much work of a physico-chemical nature going on in the Organic Chemical Institute in Moscow, especially in the high-pressure laboratory and in the sections dealing with catalytic reactions (Balandin and others).

In Leningrad it is hard to say whether the great Physico-Technical Institute, of which the head is

Academician Joffe, is of greater concern to physicists or to physical chemists. A great variety of problems are under investigation and many of them with a view to their ultimate practical application, but without any sacrifice of the fundamental scientific approach. Among the most important are: (1) the study of the remarkable properties of the thallium sulphide photo-cell, (2) the study of fibres and high polymers, and (3) a very intensive investigation of the properties of that important class of substances known as semi-conductors. In talks with some of his guests last June, Joffe explained some very liberal-minded views on the organization of research. While explaining that science was carried on for the benefit of the community, he expressed ideas on the practical realization of its aims from which the most individualistic would have had little cause to dissent.

In all the various institutes there is a lively appreciation of most of the problems which have occupied English-speaking countries of late years, and characteristic contributions are being made to most of them: kinetics and the transition state theory (Syrkin, Roginsky, Temkin and many others), photochemistry (Terenin, Kondratiev), and so on.

To watch the evolution of this great consciously directed effort will be of extraordinary interest in the next few years. In this connexion another matter arises. The knowledge of English is very widespread among our Russian colleagues. Is it not high time that we began to provide the corresponding advantage for our own younger generation of scientific men?

SURFACE CHEMISTRY

By Prof. N. K. ADAM, F.R.S.
University College, Southampton

DURING the recent celebrations of the 220th anniversary of the foundation of the Academy of Sciences of the U.S.S.R., I had the opportunity of seeing something of the very extensive and thorough researches which are in progress in surface chemistry in that country. Naturally, most of this work is being done in the Institute for Colloid and Electrochemistry, in Moscow, which is directed by Academician A. N. Frumkin; but some work on surface phenomena is going on elsewhere also.

Two lines of work appeared of exceptional interest on account of their novelty and their potentialities for extension and for practical application; these are the investigation of the promoting effect of small amounts of adsorbed gases on the catalytic power of metals, by S. Z. Roginsky and others, and of the influence of films adsorbed in the sub-microscopic cracks in solid surfaces on the tensile strength and hardness of solids, by P. A. Rehbinder and his team. Roginsky[1] finds that, as a rule, really clean metallic surfaces of platinum, nickel or tungsten have little or no catalytic power; but if a small quantity of oxygen, hydrogen or nitrogen is adsorbed on the surface, they become excellent catalysts for such reactions as the hydrogenation of ethylene. The adsorption of larger amounts of gas reduces the catalytic power, which finally diminishes to zero again when a large quantity of gas has been adsorbed. The maximum catalytic power is attained at a quite sharply defined concentration of gas adsorbed on the surface; when the amount of gas adsorbed is half, or double, that required for maximum catalytic power, the rate of the reaction is often only one fifth to one tenth of the maximum, sometimes even less. It is claimed that these catalytically active adsorbed layers, or patches covered by adsorbed layers, are remarkably stable and persist for some considerable time during which the catalysed reaction is taking place.

Rehbinder[2] has shown that such adsorbable substances as long-chain fatty acids very greatly increase the facility of slip in the glide planes of monocrystalline wires of metals, even when these are as thick as one millimetre; and also decrease greatly the tensile strength and hardness of such solids as mica, particularly when the solids are being deformed by stress. This is due to the penetration of the 'Griffith' micro-cracks found in the surface of all solids by adsorbed films, wedging open these cracks and consequently weakening the solid; and, one is tempted to suggest, possibly lubricating the slipping of one layer of the solid over another. This phenomenon may prove to be of importance in connexion with the use of fatty acids and similar substances for lubricating purposes.

One very interesting consequence of this adsorption in micro-cracks is shown when a polarizing electric potential is applied to a solid immersed in a solution of an electrolyte[3]. At that polarizing potential at which the electric charge on the solid becomes zero, there is no adsorption of ions on the solid surface from the electrolytic solution, and consequently no diminution of hardness of the solid. As the potential departs from this value, either positively or negatively, so does the concentration of adsorbed ions increase, with a consequent decrease in hardness of the metal. In fact, the curve showing the dependence of the hardness on the polarizing potential has a roughly parabolic form with a maximum hardness at the 'null' potential, in exactly the same way as the electrocapillary curve of mercury in solutions of electrolytes shows a maximum of interfacial tension. The maximum of hardness is found to be influenced by the presence of ions with high specific adsorbabilities, or by neutral organic substances, in a way very similar to that in which such substances affect the electrocapillary curve. Thus something closely similar to the electrocapillary effect can now be studied with solids. In one case at least, tellurium[4], it is said that the maximum of hardness occurs at a *positive* value of the polarizing potential, an unusual sign for the potential at the maximum.

Extensive studies on the viscosity and other mechanical properties of monolayers on water[5] as well as their influence on the stability of bubbles[6] are in progress, the results confirming and extending earlier work: A. A. Trapeznikov is also studying the effect of temperature on the spreading pressure of solids on water in very great detail[7], finding new phenomena which he claims are due to the hydration or entry of water into the solid or liquid fatty substances which spread, in the bulk phase as well as in the monolayers. V. Levich, in a mathematical investigation[8], concludes that the damping of ripples by surface films can be ascribed to their low compressibility.

B. Derjaguin is continuing a long research[9] on the distance to which the influence of a solid surface extends into liquids in contact with the solid, using a variety of methods. These include measurement of the thickness of layers of liquid remaining under definite conditions of draining, between an air bubble and a glass plate against which it is pressed, or between two air bubbles; in other experiments the thickness of liquid remaining on a glass plate, or in a wedge-shaped slit, when a strong current of air blows most of the liquid away, is measured. Optical interference methods are used; and although complex hydrodynamical effects are clearly involved, there seems good evidence that some degree of structure, with considerable anomalous viscosity, persists far into the liquid in such cases as solutions of aluminium naphthenate, and perhaps other long-chain substances, in mineral oils. The effect may perhaps extend as far as half a micron into the liquid. This work also may be of importance in the theory of lubrication.

A. Schuchowitzky has applied statistical methods to adsorbed layers at the surface of solutions[10], and A. B. Taubman[11] draws deductions from surface tension – concentration curves as to the orientation of many organic substances dissolved in water, including heterocyclic compounds, at the air – water surface.

S. Roginsky is attempting to develop a general theory of the conditions for activation of heterogeneous catalysts[12]. At present, this appears to be couched in somewhat generalized terms, but one important point is the claim that the 'degree of supersaturation', a term used for the decrease of free energy, or extent of departure from equilibrium conditions, in the reaction by which the catalyst is formed, is a prime factor in determining its catalytic activity. This supersaturation is measured, in the case of a catalyst such as nickel oxide formed by dissociation of nickel carbonate, by the expression $RT \log_e p_e/p$, where p_e is the equilibrium dissociation pressure of carbon dioxide (or other gas given off during the dissociation) and p the actual pressure prevailing in the atmosphere above the dissociating solid when the catalyst is formed; T is the absolute temperature at which the catalyst is formed. It would appear possible that the reason why this so-called 'supersaturation' of the dissociation, leading to the formation of the catalyst, is important is simply that, if the pressure during formation is very much lower than the equilibrium pressure, the catalyst is formed very rapidly, so that its atoms are arranged in an irregular manner and cannot easily re-arrange themselves to a more stable, and less catalytically active, structure.

Finally, despite the heavy duties of direction of a very large and active institute, its leader, A. N. Frumkin, is continuing active research in a number of different directions[13], with many collaborators. These include work on the amount of oxygen which must be adsorbed on pure iron to confer passivity; continuation of work on the capacity, and general theory, of the electrical double layer; on the oxidative properties of charcoal leading to the formation of hydrogen peroxide; on overpotential, wetting and swelling of graphite, electrokinetic behaviour of activated charcoal and of mercury droplets in aqueous solutions. At one of the scientific meetings of the Congress he delighted the audience with a cinematographic record of the motion of mercury drops falling at right angles to the field between two electrodes; at first these are attracted to the anode, but as they approach this closely, their surface becomes so heavily oxidized that their charge changes sign and they are repelled.

In other institutes I saw work on the rounding off of rock-salt crystals at high temperatures, under the action of surface tension; and ingenious methods for measuring the concentration of free hydrogen atoms or hydroxyl radicals in burning gases (Semenov). A long, thin glass capillary, coated on the outside with a catalyst which produces rapid recombination of the free atoms or radicals on the surface, with a thermocouple inside, measures the heat produced by this re-combination, and from this the concentration of atoms or radicals is deduced. Allowance can easily be made for the heat produced by the burning gases by inserting a second, similar capillary containing a thermocouple but without any catalyst on the outside, close to the first.

The research institutes organized to study some particular branch of science are well, indeed almost lavishly, equipped and staffed; and although the primary object of these institutes is pure scientific research, the necessary liaison with all departments of industry appears good enough to enable scientific discovery to be put into industrial operation in any direction and on any scale desired, with a minimum of delay. The policy of the Soviet Government—to support scientific research on a very generous scale, for its own sake as well as for its actual or potential technical applications—appears thoroughly sound, as a long-range policy for a co-operative society.

The Russians claim to plan their scientific research, but one sees little sign of any restriction of individual initiative; individual scientific workers of proved ability or promise appear to have a very free hand in their choice of fields of research; and they are encouraged and expected to continue in a line of work for a very long time indeed, perhaps for five or ten years or even more. The contrast with so many industrial and even Government research establishments in Britain, where fundamental scientific research is so often relegated to a very low priority, and even if attempted is under continual threat of suppression or interruption after a few months or less because of the danger that it will not be immediately remunerative to the particular industry or department which undertakes the research, is somewhat disquieting to those who have the ultimate interests of British technical efficiency as a whole at heart. Naturally, the enthusiasm and the scientific 'morale', as well as the friendliness, of the workers in the Russian scientific institutes, is at a very high level, and was a real pleasure to see.

(The papers below comprise only a selection of those published on the topics mentioned.)

[1] Roginsky, *et al.*, *Z. physik. Chem.*, A, 174, 449 (1935); *C.R. Acad. Sci. U.R.S.S.*, 30, 29 (1941); *J. Phys. Chem. (Russ.)*, 15, 1 (1941).

[2] Rehbinder *et al.*, *C. R. Acad. Sci. U.R.S.S.*, 30, 491; 32, 125 (1941).

[3] Rehbinder and Wenstrom, *Acta Physicochim. U.R.S.S.*, 19, 36 (1944).

[4] Rehbinder, private communication.

[5] Rehbinder and Trapeznikov, *Acta Physicochim. U.R.S.S.*, 9, 257 (1938). Trapeznikov *ibid.*, 9, 273 (1938); 10, 65 (1939).

[6] Trapeznikov, *Acta Physicochim. U.R.S.S.*, 13, 265 (1940)

[7] Trapeznikov, *Acta Physicochim. U.R.S.S.*, 19, 553 (1944).

[8] Levich, *Acta Physicochim. U.R.S.S.*, 14, 307 (1940).

[9] Derjaguin *et al.*, *Acta Physicochim. U.R.S.S.*, 10, 44, 153 (1939); 12, 314 (1940), 19, 541 (1944); 20, 35 (1945). *C.R. Acad. Sci. U.S.S.R.*, 23, 671 (1939); 28, 332 (1940); 39, 13 (1943).

[10] Schuchowitzky, *Acta Physicochim. U.R.S.S.*, 19, 176, 508 (1944).

[11] Taubman, *C.R. Acad. Sci. U.R.S.S.*, 29, 22, 103 (1940).

[12] Roginsky *et al.*, *Acta Physicochim. U.R.S.S.*, 4, 729 (1936); 19, 225 (1944). *J. Appl. Chem. U.S.S.R.*, 17, 97 (1944).

[13] Frumkin *et al.*, *Acta Physicochim. U.R.S.S.*, 18, 23, 242, 325, 341, 351, 473 (1943). *C.R. Acad. Sci. U.R.S.S.*, 32, 327 (1941). A. I. Pankratov, *C.R. Acad. Sci. U.R.S.S.*, 24, 149 (1939). Bach, N., *Acta Physicochim. U.R.S.S.*, 14, 463 (1941). Ershler, B., *Acta Physicochim. U.R.S.S.*, 19, 139 (1944).

(To be continued.)

POST-WAR FOREST POLICY IN INDIA

By Prof. E. P. STEBBING
University of Edinburgh

EIGHTY years have passed since the Indian Forest Service was inaugurated under the auspices of Sir Charles Wood, Secretary of State for India, Lord Elgin, Governor-General of India, and Mr. (later Sir Dietrich) Brandis, its first Inspector-General of Forests. It was the first forest service in the British Empire and Dominions, and the first attempt by the British Government to introduce a correct forestry administration into a country over which it ruled. Various factors, including the steady recruitment of its gazetted service from home and the high standard of training demanded by the India Office for its forest probationers, have gone to produce the forest service and the great forest estate it controlled up to the outbreak of the War of 1914–18. Perhaps one of the chief causes, accounting for the steady progress in achievement for the well-being of the forests and the people, so large a proportion of whom are dependent in many ways on efficient forest management, has been the presence of an Inspector-General of Forests as adviser to the Central Government without intermission down through this long term of years. Many a period of storm and stress, as one looks back, threatening one or more forest regions in different parts of India, were safely negotiated through the presence at the ear of the Central Government of a cool and far-seeing forestry administrator who, with his great experience, could weigh impartially the pros and cons of any policy suggested by a local administration, and advise accordingly.

It was not until 1894 that the aims which had influenced the work of the Forest Department were voiced in Circular No. 22F. "A Note on 'Post-War Forest Policy for India'" was written last year by Sir Herbert Howard, Inspector-General of Forests (Manager, Government Press, New Delhi, 1944). The Inspector-General thus summarizes the principles embodied in this memorandum: (*a*) First and foremost, the preservation of the climatic and physical conditions of the country come before all other objects. (*b*) The preservation of the minimum amount of forest necessary for the well-being of the country is second only to (*a*) above. (*c*) Agriculture and cultivation come before forestry in the use of the soil. (*d*) The satisfaction of the requirements of the local population, given either free or at competitive rates, comes before revenue. (*e*) With the above objects fully provided for, the realization from the forest area of revenue to the greatest amount which efficient management permits.

If the order of the above objects of a correct forest management in a country is examined, it will be observed that after thirty years of forestry administration in the different parts of India, the Central Government and its adviser had fully appreciated that the chief role of the forest—Nature's forest which had not been grown by man—in a countryside was not the provision of revenue, and that the maintenance of an adequate forest staff should not be dependent upon the amount of revenue which came from the forests; that, in other words, the *raison d'être* of the forests of a region might fulfil far greater and more important objects than the mere provision of money. It would be incorrect to say that the excellent rules laid down in this circular were carried out to the letter all over India. There were serious back-slidings. But the present great forest estate of the country is witness to the fine work achieved, and that, to a considerable extent, the value of the forests and of the work is appreciated by the people.

Although more could not be expected at the time, the Circular of 1894 only related to the forests under the control of the forest service, that is, the reserved forests placed under a regulated management based on a sustained yield. This meant that private forests, as also the considerable forest areas under the Indian States, remained outside all Government forest supervision, though during the present century some of the Indian States had begun to recruit Indians trained in the forestry schools of Britain.

Howard's note is written for British India, but much of it has equal application to the Indian States. It is divided into two parts: Part 1, a review of present conditions, and Part 2, the Inspector-General's suggestions for the future. These are both considered under (1) the Government in relation to forestry; (2) existing forest policy; (3) existing demands on and supplies of forest resources; (4) floods, erosion and desiccation; (5) forest research; (6) forest education; (7) creation of a federal forest service; and (8) minor forest produce. From the point of view of general forest policy, it is the first four of these that are of primary importance, the others, important as they are, being more for internal consideration. It will be necessary here to confine ourselves to Howard's suggestions in Part 2.

Under the minimum forest area necessary for the well-being of a country—a subject probably now of the first importance to almost every highly populated country on the globe—Howard shows that the area of forest under Government control comprises only 14 per cent of the area of British India. Certain provinces, such as Assam, have large areas of the so-called State unclassed forests, which are not under professional forest management; but for India as a whole the forests are badly distributed. Except for the Central Provinces, Bombay and Madras, roughly speaking, south of a line from the Gulf of Cambay to Calcutta the forests under the Indian Forest Service consist of those along the foothills of the Himalaya, a narrow band only, the Assam forests and the Sundarbans, south of Calcutta, and smaller areas on the banks of the Indus, in the south of the United Provinces and in Bihar and Orissa. Reliable figures for the privately owned forests do not exist; but it is doubted whether the total including the Government forests would exceed 20 per cent; while there is no sort of forest management in the private forests, which are rapidly disappearing under the hand of the unchecked timber-felling contractors or the unchecked grazing accompanied by fire in the hot season at the hands of the villagers. In European countries the average forest area in a State, including State, communal and private forests, amounts to 26 per cent. In British India, a fundamentally agricultural country, the total area of forest is less than that required, and its distribution is bad.

Howard points out that the existing forest policy does not include suggestions that the forest area of the country should be increased chiefly by additional Government forest reserves. The present policy restricts itself to the ruling that agriculture should not be allowed to encroach on reserved forest to the extent of reducing the forest area below the minimum required for the well-being of the country, considered to be 20–25 per cent. Allusion is made to erosion and floods caused by the removal of forest growth in considerable parts of the outer Himalaya and other hill areas in the country, necessitating an increase of forest as an aim of post-war policy. Three ways are suggested: (*a*) by afforesting or improving impoverished areas of Government waste lands; (*b*) by bringing more private and communal lands, where available, under forest by propaganda and assistance in their management; (*c*) by the legal control of the management of private and communal forests to prevent deforestation. The Indian Forest Act contained clauses providing for control over private forests, but forest officers had found it practically impossible to enforce them. In some provinces fresh legislation is being drafted to provide for practical supervision. The suggestions of the Inspector-General are: (1) The acceptance of the aim that 20–25 per cent of British India should be brought under correct forest management, and so far as possible in each of the provinces; (2) the enactment of a Private Forest Act to supplement the present India Forest Act in each province.

Chapter 3 of the post-war proposals discusses supplies and consumers under: (*a*) general consumers, mainly urban, whose needs are mainly met by the timber trade; (*b*) local village consumers residing close to a source of forest resources; and (*c*) ordinary village consumers who live far distant from any source of forest produce. No serious problem is involved, says the writer, in respect of the first two of these classes, either the chiefly urban or the villager residing near the forest areas. It is the third class of consumers who has been inadequately provided with forest materials, in several cases, for periods which run into centuries, as, for example, in Bengal. The post-war proposals in reference to this class are of the first importance. It is estimated with more certainty than is the case with most estimates of this type that large parts of the Punjab and the North-West Frontier Province, probably 90 per cent of the plains' villages in the United Provinces, all the centre and west of Bengal, much of Bihar and the coast lands of Orissa and possibly half the Bombay Presidency contain populations with an almost completely unsupplied demand for forest produce, firewood in particular. Lack of fuel in India has involved the use of cow-dung for cooking purposes, for example, for centuries in large areas of Bengal; it is estimated that somewhere about 43,000 square miles, or 13 per cent of the whole of the cultivated tracts of India, could be manured if wood fuel were available to the peasant for cooking purposes. In other words, for large areas or sections of the countryside, if fuel can be made by the formation of plantations, fuel forests, or minor forests (the name by which they are called is immaterial) in small blocks carefully sited so as to be evenly situated over the forestless area concerned, a very considerable amount of manure will be directed to its rightful purpose, the land.

This proposal, the most vital one in the Inspector-General's post-war forest policy report, it is estimated, will mean the creation of 100,000 square miles of additional forest—a sufficiently formidable scheme when it is remembered that the forest staff will have to make themselves conversant with the soils of a particular tract on which it is wished to site a future block (of no large size, but compact) of forest for the provision of fuel and small house timber. Usually in India hitherto, in the districts, land has been classified into cultivated and uncultivated lands solely from the agricultural point of view, the latter being subdivided into cultivable waste other than fallow and land not available for cultivation. It is suggested that uncultivated lands should in future be classified as: (*a*) waste lands other than fallow on which minor forests could be grown (that is, fuel forests), and (*b*) land not available for forest cultivation. It is considered that such a classification will not require any elaborate machinery, since the selection of areas to be utilized for these fuel reserves could be left to the forest officers, who would be responsible for the actual planning of operations. I am given to understand that Bengal has already made considerable headway in this matter, the parts of the country intimately concerned in this matter having been investigated by the Chief Conservator of Forests and members of his staff and preliminary proposals drafted. If the work is to meet with success from the outset, as is most desirable, it would appear essential that an increase of forestry staff should be made, and that carefully selected members should be detailed to carry out these far from easy operations, which will be of such vital importance to the community and the country.

On the subject of the reserved forests of India as a whole, such was the degree of efficiency reached in their management that the Inspector-General is able to write that little is required to restore the departure from normal, that is, the excess war fellings; a 40–50 per cent reduction in pre-war yields for a period of five to ten years may in some cases be necessary. The true position can be determined by the revision of the working plans, which must therefore be accelerated after the War. What other country in the world with the possible, though doubtful, exception of one or two in Europe, could make such a confident statement about its war fellings and give such an estimate of the period—and so short a period—in which the excess could be brought to normal again? With such a forest record India will fully deserve all the assistance she can be given in her new effort to bring about a more even distribution of her forests, particularly those providing more especially, if not solely, for her huge agricultural population. For a higher fertility of her soils will furnish at least one answer to the question as to how she is to maintain her increasing population.

Space will not permit of following the Inspector-General's suggestions on floods, erosion and desiccation, forest research, forest education and minor forest produce. It is proposed—and the proposal has now been carried out—that the posts of Inspector-General of Forests and president of the Forest Research Institute and Colleges, which were amalgamated in 1925, with headquarters at Dehra Dun, should be separated, the Inspector-General going back to the headquarters of the Government of India at Delhi and Simla. This was a most desirable move. The idea of a federal service, which had already been suggested by Sir Jogendra Singh, was to provide for the staffing of posts under the Central Government and possibly interchangeable with men from the provinces. It would mean that the majority of the gazetted officers at the Forest Research Institute and posts such as the Andamans, Coorg, etc., and special forest officers to draw up working plans and give professional advice to individual States and agencies, would be placed on a federal list. Sir Jogendra's suggestion appears to be eminently practical and one well worth bringing to realization.

The picture would be overdrawn if it were said that this report on post-war forest policy for India and the suggestions contained in it are in many directions the most important document drawn up for India's forests since the dispatches of the Secretary of State for India and the Governor-General written in 1862, dispatches which brought about the inauguration of the Indian Forest Department.

NUTRITION IN JAMAICA

IN a report prepared by the Nutritional Committee of the Jamaica Branch of the British Medical Association, Dr. W. E. McCulloch and his colleagues have explored the future position as to nutrition and agriculture in Jamaica, when the resolutions of the Hot Springs Conference come to be implemented.

While there is little or no difficulty in formulating a dietary of what the people should eat within the list of available local and imported foods, difficulties begin when the 'how' has to be considered. It is here that one comes up against what is probably a problem common to all those countries which depend very largely on agricultural exports for their economic existence—the conflicting interests of local nutrition and the export trade. This problem is most critical in those countries which, like Jamaica, are densely populated. The suggestion made in the report under notice for the solution of this problem is the intensification of agricultural production.

Considering the report in detail, the Committee accepts the findings of the 1937 Nutritional Committee of Jamaica, and remarks that the condition has been accentuated by the War, which has limited imports. The two main findings of the 1937 Committee were that the nutritional state of a distressingly large proportion of the labouring classes must be classed as definitely bad, and that the chief features of the island's unbalanced dietary were the deficiencies of animal protein and animal fats and the excess of starchy foods.

As a standard at which to aim, the Committee adopted Plan 1 of the Hot Springs Conference (which is relatively economical and suited to a poor population) and has translated it into tons of foodstuffs necessary to feed the Jamaican population of 1¼ millions. This estimate has been compared with what Jamaica actually ate in 1942. The calculated daily calorie consumption was 1,779, as against the Hot Springs standard of 2,688. Substances eaten in excess of requirements were those of a bulky nature such as ground provisions (yams and roots of various sorts) and vegetables and fruits (other than citrous fruits); while the chief deficiencies (per man per day) occurred with milk, 1/7 oz. as compared with 20 oz.; eggs, 5 per man per annum compared with 228; fats, ¼ oz. compared with 2 1/5 oz.; grain (as flour), 2¾ oz. compared with 10 oz.; and meat and fish, 2 oz. compared with 4 oz.

The Committee then goes on to translate these deficiencies in food requirements into acres required to produce them on the basis of the present production per acre; for example, a ration of 20 oz. (1 pint) of milk per day means 60 million gallons per year, which at present production-rates means 158,750 milking cows, or including dry cows and heifers reared for replacement, 264,000 cattle. This number of cattle would require 792,000 acres to maintain them. The total acreage required (allowing for the importation of 50,000 tons of wheat and 15,500 tons of rice) under existing methods of agriculture would be as follows (in thousand acres): cereals, 83; roots, 20; pulses, 20; citrus, 3; milk, 792; beef, 1,836; a total of 2,754,000 acres. With additions for other things such as green vegetables, the total would exceed 3,000,000 acres. The actual acreage available in Jamaica, excluding some 586,000 acres in forest, towns, etc., is 2,250,000 acres, and much of this is not suitable for permanent cultivation.

Moreover, the economy of Jamaica is based on the production of agricultural produce for export to provide money for the importation of manufactured goods, flour, etc. These crops (as for example, sugar cane, 100,000 acres, and bananas, 150,000 acres) utilize the best available land for their purpose, and in total require 350,000 acres. It is thus clearly demonstrated that competition for land between export crops, food for domestic livestock and potential food for man has already reached a stage in Jamaica where it is impossible of solution if the present methods of agricultural practice continue. This is the outstanding conclusion of the Committee.

The Committee recommends therefore a complete revolution in Jamaica's agricultural system, which would include improved and more intensive methods of production. In particular, the first requirement is to increase the efficiency of the livestock industries, since there is an appalling competition for land between man and cattle. It is pointed out that Jamaica can no longer afford 2–3 acres to feed one cow giving about 300 gallons of milk, or a range steer to produce some 500 lb. of meat. A swing-over from beef to milk production is also recommended. Increased production of peanuts and soya beans would do much to supplement the meat supply. The productive land should be used in a cycle which includes cattle, but the land cannot be permitted to be used solely for beef cattle. The local production of rice on reclaimed swamps and the production of food yeast from molasses are among other items suggested; but it is pointed out that while the addition to the ration of vitamin B_1 from yeast will be an advantage, it will not reduce the need for the other constituents of a good ration for children. The Committee quotes in detail Dr. Platt's recommendations for an immediate aim for nutrition in Jamaica, but considers that these will not altogether satisfy the social needs or meet economic requirements, and so it proposes an amended dietary as a basis for agricultural policy. It is convinced that the increased production required to meet the 'intermediate diet' could then be attained by increased output of produce per acre; increased acreage should not be required. The Committee concludes by saying that it considers that by increased efficiency and harder work, the aims of nutrition and economics are attainable in the next few years, and that both can be made to fit into the requirements of the land and the farmer. Neither efficiency nor hard work can, however, be achieved unless good food is plentifully available to rich and poor alike. If higher standards of efficiency and greater output *per capita* of population as well as per unit of land cannot be achieved, then the outlook for Jamaica cannot be regarded as anything but poor.

The Committee's report is a most interesting and important document, and worthy of study by all those who are engaged in nutrition or agriculture; it can well serve as a model in method for those who are considering such problems.

OBITUARIES

Dr. Gustav Senn

Dr. Gustav Senn, professor of botany in the University of Basel, died there suddenly on the morning of July 10. His colleagues and other friends were preparing a *Festschrift* to be given him on November 9, his seventieth birthday.

Gustav Senn wrote his inaugural dissertation in 1899 on certain colonial unicellular algæ; and he dealt about the same time with several families of the lower algæ for Engler and Prantl. In several subsequent papers he discussed the arrangement of chlorophyll and 'chromatophores' in algæ and in higher plants. He wrote a useful little Flora of the Western Alps about forty years ago, and published a number of papers on the special physiology of Alpine plants in relation to light and temperature.

But Senn was chiefly remarkable for his admirable knowledge of Greek, and for his devotion to Theophrastus and other lesser sources of Greek botany; herein he was the legitimate successor to the last of our own scholar-botanists, Sir William Thiselton-Dyer. Senn had ambitious schemes in hand, including a revised text and translation of Theophrastus; but he was a slow and most cautious worker, and has left a deal of work undone. The last time I saw him, just before the War, we talked of a difficult and confused part of Theophrastus' work on "The Causes of Plants"; he had cut up and pieced together several pages of the book, and as he thought, and as it seemed to me, the re-arranged paragraphs fell simply and obviously into two separate versions of the story.

Among Senn's classical papers was one on the Theophrastean pine trees of the north-east Mediterranean: that is to say, on the stone pine, the Corsican pine and the Aleppo pine, in Macedonia, in Arcady and on Mount Ida. Another deals with "Theophrasts Differential-Diagnosen für laubwerfende Eichen"; in other words, on the various deciduous oaks, and their somewhat peculiar limitations of habitat and distribution. The number of species to be dealt with is considerable, including *Q. Robur, Aegilops, Cerris, lanuginosa, pedunculata,* and perhaps one or two more; and Senn's identification of the Greek names differs in several instances from Dyer's. In yet another paper, on the Greek fir trees, Senn argues (again against Dyer) that what Theophrastus calls the male and female fir are really distinct species. One is the common Greek fir tree, *A. Apollinis*, Link, of which *A. cephalonica* is a local form; the other, *A. alba*, Miller (= *Pinus Picea*, L.), grows further north, and forms great woods in Macedonia. A better-known and still more curious paper is one on "Oak-galls in the Historia Plantarum of Theophrastus", published in the *Transactions of the Royal Society of Edinburgh* in 1941 (see *Nature*, April 17, 1937, p. 684). Theophrastus mentions ten kinds of gall on various oaks, giving a very few words to each; and Senn succeeds in identifying every one of these, the common oak apple being the only one of which the identification remains a little dubious. Dyer identified, with more or less certainty, a vast number of Greek names of the higher plants; but he gave no heed to such things as galls, nor to the various fungi and fungoid diseases to which Theophrastus makes passing allusion. Here Senn stood alone. I asked him once if he could explain two diseases of the fig-tree which Theophrastus mentions—the so-called 'rot' (or *sphacelismus*), in which the roots turn black, and the *krados*, in which the leaves do so. He told me that the one was what the French call *la pourridie* (*Dematophora necatrix*, R. Hartig); and the other was caused by *Fumago vagans*, Pers., the sign of which is a sooty dust upon the leaves. Let the revisers of "Liddell and Scott" take note of these!

D'Arcy W. Thompson.

Prebendary Lonsdale Ragg

The death of the Venerable Lonsdale Ragg at the ripe age of seventy-nine years has deprived forestry and botanists in general of one who for many years had fostered by all means in his power an interest in trees. He was born in 1866, the son of a country clergyman in Shropshire, and no doubt his upbringing in that delightful county did much to influence his work in future years. His clerical career was distinguished, for he was Prebendary of Buckden in Lincoln Cathedral and had been Archdeacon of Gibraltar since 1934. He was, in fact, particularly interested in the Mediterranean countries, and in his earlier years had served in various chaplaincies in Italy and elsewhere, publishing many theological theses on the history of religion in that region.

To a wider public, however, Lonsdale Ragg was known for his interest in trees, and particularly for his beautiful illustrations of tree-life. He had been editor of the quarterly magazine *Tree Lover* from 1932, and its pages are full of his contributions and of his delightful sketches of trees. These black-and-white illustrations of typical trees were not only most artistic, but were also very accurate as to detail. Although he usually concentrated on depicting particular specimens, some of his work shows that he was also equally competent in producing more general scenes, as is exemplified by his scenes of "Bath after the Blitz" and "The Charm of Foliage"—a drawing of Sydney Gardens in Bath. It was in this city that he had made his home in recent years, and its picturesque surroundings gave him ample scope for practising his art. Many of his sketches consist of details of the trunk and lower branches of some particular giant, and he was particularly interested in famous and historic trees, especially large and well-grown specimens. There is a sketch of a specimen of *Robinia pseudoacacia* at Warminster, with a height of 85 ft. and a girth of 21 ft. 6 in., which is typical of his work.

Lonsdale Ragg kept up his interest in trees until the end of his life. He was a frequent visitor to Kew until recently, when increasing infirmity rendered the journey from Bath under war-time conditions difficult. He was indeed a tree lover, and one of his last communications with the Royal Botanic Gardens concerned the dimensions of a specimen of Monterey cypress which he had discovered near Lyme Regis. He had hoped that this was the largest specimen in the British Isles and was somewhat disappointed when it was pointed out that larger specimens existed.

As a man Lonsdale Ragg possessed great charm, and his enthusiasm together with his old-world courtesy endeared him to all with whom he came in contact. His writings, his sketches and above all his delightful personality will be missed by all tree lovers.

G. Evans.

Sir William H. Ellis, G.B.E.

Sir William Henry Ellis, who died at Sheffield on July 4 at the age of eighty-four, was the fourth son of John Devonshire Ellis, one of the original partners in John Brown and Company, armour plate and steel manufacturers of Atlas Works, Sheffield.

Sir William was born at Thurnscoe Hall in the county of York on August 20, 1860. He was educated at Uppingham School, and entered the works of Tannett Walker and Co., Ltd., of Leeds, in November 1878, passing through their various shops and drawing office. In 1882 he had charge, on their behalf, of the erection of a vertical blowing engine at some copper smelting works in Servia, and afterwards was, for two years, a foreman in their erecting shop in Leeds. In October 1885 he went to Sheffield to take charge of the erection of a 4,000-ton hydraulic forging press, a pair of hydraulic pumping engines and two 150-ton overhead travelling cranes in connexion with the press. At the completion of this work in October 1887, he entered the employment of John Brown and Co., Ltd., Sheffield, as under-manager of their forge department. He was appointed a director of the Company in 1906 and became managing director in 1919.

Throughout his career Sir William displayed marked ability in technical, commercial and administrative work, and in addition, found time to render valuable public service. Among the many positions he has occupied, it is worth while putting on record here that he had been president of the Institution of Civil Engineers, of the Iron and Steel Institute, of the Sheffield Society of Engineers and Metallurgists, and of Section G (Engineering) of the British Association at the Glasgow meeting in 1928. He was Master Cutler in 1914, 1915, 1916 and 1917. He was a member of the Council of the University of Sheffield, of the Executive Board of the National Physical Laboratory, of the governing body of the Imperial College of Science and Technology and of the Cambridge University Appointments Board. He was also a member of the Committee of Privy Council for the Department of Scientific and Industrial Research, and of the Government committee on drainage in the Doncaster area.

Sir William was a member of the Swiss Alpine Club, a keen and intrepid mountaineer, and did much to assist Swiss guides in their retirement. He climbed the Matterhorn on his seventieth birthday. The Derbyshire moorlands were an open book to him. He looked forward to his week-ends, when walks of 16–20 miles over the wild heather-clad moors and fells of the Pennines were his delight and afforded him mental rest, in invigorating air, and equipped him for the work of the ensuing week.

On the artistic side Sir William was an accomplished organist, and loved to entertain friends in the evenings with selections from famous composers.

Sir William was a man of outstanding ability, tenacious in the pursuit of his object, and prior to his retirement from John Brown and Co., Ltd., was extremely active in the industrial life of Sheffield. He was a warm-hearted friend, and his passing leaves a gap in the ranks of Sheffield's old prominent citizens.

J. F. Bridge.

We regret to announce the following deaths:

Prof. J. Davidson, head of the Department of Entomology, Waite Agricultural Research Institute, and professor of entomology in the University of Adelaide, aged sixty.

Mr. J. S. Highfield, consulting engineer, a past-president and honorary member of the Institution of Electrical Engineers, on August 15, aged seventy-three.

Prof. L. Wertenstein, formerly of the Mirosław Kernbaum Radiological Laboratory of the Warsaw Society of Sciences, during a bombardment of Budapest in January 1945.

Prof. J. T. Wilson, F.R.S., emeritus professor of anatomy in the University of Cambridge, on September 2, aged eighty-four.

NEWS and VIEWS

Dr. H. J. Gough, C.B., M.B.E., F.R.S.

The announcement that Dr. H. J. Gough has relinquished the post of director-general of scientific research and development, Ministry of Supply, to become engineering chief of Messrs. Lever and Unilever Ltd., is of particular interest at the present time, since it means that British industry will have the full benefit of the accumulated experience of an engineer-scientist who has shown outstanding ability, first as an individual scientific investigator and then, during the war years, as one of the most responsible scientific administrators in the Government service. As a young man, Dr. Gough served with distinction in the Royal Engineers in the War of 1914–18 and then returned to the Engineering Department of the National Physical Laboratory to carry out the valuable researches on the causes of deformation and failure of engineering materials with which his name will always be associated. He rapidly became recognized as the leading authority in Great Britain on the important subject of the behaviour of metals under repeated or fatigue loading, and although always interested in the application of his researches to engineering practice, demonstrated very fully in his own work how invaluable it is to utilize fundamental metallurgical and physical science in the solution of engineering problems. Dr. Gough succeeded the late Sir Thomas Stanton as superintendent of the Engineering Department of the National Physical Laboratory in 1930, and in this position not only continued his personal researches, but was also responsible for the initiation of many valuable researches in engineering materials and design, applied fluid mechanics, ballistics and lubrication. His researches and authoritative lectures did much to enhance the high reputation of the National Physical Laboratory in engineering research. In 1938 Dr. Gough was appointed the first director of scientific research at the War Office, and almost immediately had to face the tremendous task of organizing and directing the scientific activities of the newly created Ministry of Supply. This work called for all his abilities and almost inexhaustible energy, and can perhaps be summed up by saying that Dr. Gough, perhaps more than any other individual, was responsible for the many advantages which applied science has been able to give to the British Army in its successful fight.

Chair of Geography at the London School of Economics

Prof. Ll. Rodwell Jones

THE retirement of Prof. Llewellyn Rodwell Jones under the age-limit marks the termination of twenty years tenure of the chair of geography in the University of London at the London School of Economics, where he succeeded Sir Halford Mackinder as head of the Department. After a period as a school-master, he lectured for a year in the University of Leeds, before serving during 1914–19 in the West Yorkshire Regiment, which he left with the rank of major and with an M.C. to take up a lectureship at the London School of Economics. Under Mackinder's guidance, Rodwell Jones and his sister (afterwards Dr. Hilda Ormsby) laid the foundations of one of the strongest schools of geography in Britain, very wisely joining forces with King's College, London. Under this inter-collegiate arrangement, Rodwell Jones secured for his specialist staff the ideal opportunities of combining research and lecturing in their own fields, and avoided what is so often the curse of university departments, namely, too great a burden of lecturing on any one member of the staff. As a result, a constant stream of original work has emanated from the Department.

Rodwell Jones's own interests were particularly in the historical and economic geography of North America, and it was after a period as visiting professor in the University of Chicago that he published in conjunction with a former student of the School, Dr. P. W. Bryan, his standard work on North America, now in its seventh edition. Always constructively critical, his meticulous attention to detail is well shown in his volume on "The Geography of London River" (1931). His influence on the progress of geography in Great Britain cannot be measured by his published works. As an ideal chief, an ever-helpful colleague, and inspiring lecturer, he succeeded in imparting an enthusiasm for his subject to successive generations of students. It is no accident that those students now occupy the headships of geography departments in half a dozen universities in Britain and the Empire.

Dr. L. Dudley Stamp

THE appointment of Dr. L. Dudley Stamp to the chair of geography at the London School of Economics and Political Science, made vacant by the retirement of Prof. Rodwell Jones, does not involve him in any change of location, for he has long held a Cassel readership at the School. No doubt he will re-establish the fruitful connexion with the Geography Department at King's College, which was broken by the War. Prof. Stamp has travelled in most parts of the world, and has spoken and written on many subjects, but his best-known work is that of the Land Utilisation Survey. This series of maps and memoirs on the counties of Britain has been found invaluable, not only in academic regional studies, but also as a guide to planning and reconstruction, particularly in respect of rural land use. As regards the latter, Prof. Stamp is chief adviser to the Ministry of Agriculture. Like his late brother, Lord Stamp, he is a persuasive and lucid speaker and writer, and has done much 'to carry geography into the market-place'; not, of course, without danger to his reputation, since it is almost impossible to be simultaneously simple and precise. But Ministers are impatient of indeterminacy, and of exact answers promised for delivery fifty years hence. They are required to take action here and now, and the scientific worker must take the risk of offering advice based upon a first approximation. It was not very long ago that Prof. Stamp's gift of exposition carried all the lay members of an important committee with him, leaving the only other expert, an economist (who in this instance was probably in the right), to carry his orthodoxy into the dusk of a minority report, and thence to Cambridge. But more than one economist now recognizes that the location of industry (to take but one example) has some relation to locality, and since geography is the minute study of locality and its significance, the association of a Department of Geography with a School of Economics holds possibilities of real usefulness. These possibilities, it is to be hoped, Prof. Stamp will have the opportunity to develop.

Science and Education in India

MR. L. J. F. BRIMBLE, joint editor of *Nature*, has recently returned from a short but intensive tour of India and Burma, where he not only made cultural and educational contacts with British and other troops in South-east Asia Command, but was also able to visit a number of scientific and educational institutions in various parts, mainly Calcutta. It is hoped, in due course, to publish a more extensive account of the contacts made, but men of science in Britain will be glad to know that the Editor has returned inspired by the enthusiastic way in which their Indian colleagues are working for the advancement of science and education in India. The hospitality extended to him by Indian men of science left nothing to be desired; in fact, he found it quite impossible to accept all invitations. Though it is not possible, at present, to discuss details or mention all individuals, it is impossible, even in a short note, to omit mentioning the kindness of Prof. M. Saha, professor of pure physics in the University of Calcutta. Under Prof. Saha's guidance the Editor was able to see most of the departments of the physical sciences in various colleges of the University. He saw the cyclotron which, after three years work on it, is nearing completion. It only remains for a few parts to arrive from the United States before research work with this instrument can begin. Prof. P. N. Ghosh, Prof. S. K. Mitra and Prof. S. N. Basu were also helpful in showing the work going on in the departments of pure and applied physics. The pure and applied chemistry departments were visited under the guidance of Prof. J. N. Mukherji and other professors. Here the Editor had the honour of visiting the room in which Sir P. C. Ray lived and died.

Many biology departments were also visited, mainly at the University College of Science (under the guidance of Profs. S. P. Agharkar, H. K. Mookerjee and their assistants) and at Presidency College (under the guidance of Profs. J. C. Sen Gupta, S. Banerjee and others). The work of other science departments was explained by their various heads and assistants. Mr. Brimble is particularly grateful for the kind hospitality of the statistician, Prof. P. C. Mahalanobis, professor of physics in Presidency College and the founder of the Statistical Laboratory, Calcutta. Mr. Brimble was able to address the students of the University and also certain sections of the staff. He had a fruitful discussion with Dr. R. Pal (vice-chancellor), Dr. B. C. Roy (president of the Post-graduate Department), Dr. S. Mookerjee (former vice-chancellor), the Hon. Justice Mr. C. C.

Biswas, and other members of the University Senate. Under the guidance of Dr. K. Biswas, an interesting visit was paid to the Royal Botanic Garden, Sibpur, of which Dr. Biswas is superintendent. There he was able to meet other botanists, including Prof. S. A. Bose, of the Carmichael Medical College, Prof. J. C. Sen Gupta, of Presidency College, Dr. P. C. Biswas, anthropologist in the University, and others. Some time was also spent in visiting the All India Institute of Hygiene and Public Health, the School of Tropical Medicine and other centres of medical research. Many other men of science were met, both in Calcutta and Allahabad and elsewhere. Of more special interest was the visit paid to the offices of *Science and Culture*, of which Prof. Saha is an Editor. These offices are situated in the University College of Science.

The Editor has been asked to convey greetings to British men of science from their Indian colleagues, and has also brought many private messages for individuals. He hopes to convey these in due course.

Peoples of India

The condensation of a description of a vast and complex country like India into a booklet of some 85 pages, including illustrations, is no mean feat, especially when the result is so clear and informative. Wm. H. Gilbert, jun., has done this in War Background Studies, No. 18, entitled "Peoples of India", issued by the Smithsonian Institution. Starting with the environment (geographical, climatic and biological), the author passes on to the inhabitants; these are of diverse origins as is well known, and thus lay the foundations for the complicated aggregation that is India. Most of the so-called races of man are represented there. When it is realized, moreover, that there are about 180 different languages, apart from 550 dialects, in the country, there is no denying that the difficulties of administration are great. Although India shows great ethnic diversity, there is at the same time a certain cultural unity. The people as a whole may be described as sharing certain traits such as conservatism, a lack of time sense, a love of social prestige, a highly developed religious sense and a strong devotion to the family. The mental abilities of certain castes are unquestioned, as shown by their metaphysics and by their art, to mention only two examples. Caste coupled with religion is perhaps the outstanding characteristic of India. The caste system, faulty though it may be, at least has the merit of bringing order into what might otherwise be a discordant assemblage of peoples. The book ends with a short account of Indian contribution to the War, and it is illustrated with fine photographs which do much to emphasize the essential contrasts in India of great riches and abject poverty, of fine buildings and squalid huts.

Food Policy in Britain

Discussion Circle, No. 2 (Craig and Wilson, 70 Bath Street, Glasgow), opens with an article by Sir John Boyd Orr, entitled "If I were Minister of Food in Peace-time". The first thing that might be done, says Sir John, is to get out a statement of the findings and recommendations of the United Nations Food and Agricultural Conference, the delegates of which represented 80 per cent of the world's population. They unanimously declared that: (1) the kind of food needed is known; (2) even in the best fed countries, 20–30 per cent of the population do not obtain sufficient of the right kinds of food essenti for health; (3) lack of sufficient of the right kin of food is the cause of disease, physical disabilit and untimely death; (4) the first cause of lack food is poverty; (5) we have the knowledge an ability to produce all the food needed. The Conferen also recommended that every nation should provi a diet adequate for the health of the citizens, an these recommendations have been accepted so far they affect Great Britain. If, continues Sir Joh you were Minister of Food, the first decision whi you would have to make would be whether yo would carry out these recommendations, and, befo you made this decision, you would have to consid what would happen if you did carry them ou Opinions on this will differ. Sir John bases his esti ate of what would happen on what did happen whe we changed the national diet between the War 1914–18 and the present time. During this peri the average consumption of foods of special val for health increased by about 50 per cent, and the was also a remarkable improvement in nation health. Certain deficiency diseases, such as ricket almost completely disappeared; children were nearl three inches taller, and infant mortality fell by mo than 30 per cent, and deaths from tuberculosis b more than 50 per cent. Other factors undoubtedl helped to produce this result; but the improvemen in the national diet was, Sir John thinks, the ou standing change. During the recent War, the foo policy of Britain has been based upon nutrition needs. The special needs of mothers and childre have been provided for, and the diet of the workin class is therefore now better than it was before th War.

To maintain this improvement Sir John sugges that the Government should appoint a food an agricultural commission. The commission would nee to own, or at least to control, the processing centr such as flour mills, slaughter houses, bacon factori and milk depots if it were to give a guarantee market. The wholesale food trade would purcha from the commission all its supplies at a wholesa price calculated in such a way that, by the cheape method of distribution, namely, cash and carr retail prices would be adjusted to the capacity of th poorest families. The provision for the poor of a adequate diet would go far to abolish poverty itsel and the guarantee that there would be no lack food adequate for health would do much to abolis one of the worst fears of poverty.

New Zealand Forest Service

The annual report of the New Zealand State Fores Service for 1944 (Gov. Printer, Wellington, 1944) i fully up to pre-war standard both in make-up an contents. A separate report on post-war forest polic being under preparation, only a brief reference to thi subject is made. In one of the reports pub lished during the War, the Department pointed ou that the only realistic and economic solution of th problem of erosion control lies in Dominion-wid control of land-burning operations. This contentio is now winning wide recognition, and suppor from the various advisory committees functionin under the Soil-Conservation Council is being re ceived. It is added that a great step forward wil be achieved if the newly appointed catchment board concentrate upon this phase of their operations During the War, the Department has been immersed as is the case with most other forest departments, i war production. The shortage of man-power was still a major problem. Some alleviation resulted from the return of forestry units from Great Britain and of men from the Middle East, together with a number returned from the Armed Forces within New Zealand. The chief problem was to maintain the large number of saw-mills at maximum production; the continued transfer of semi-skilled and inexperienced workers from other industries to forest and saw-milling work making it difficult to maintain a high production. The cessation of construction of defensive works against a Japanese invasion and the recent release of a substantial number of men from the Pacific theatre of war for service in the timber industry has resulted in a material improvement.

Ball Lightning

The *Ayrshire Post* of August 10 contains a description of what is described as a fireball, which caused considerable damage on the night of Sunday, August 5. The so-called fireball was associated with a thunderstorm which reached Ayr from the north shortly before 8.30 and passed quickly away. It caused serious damage to a house at 6 Teviot Street, Ayr. From the descriptions of those who saw the phenomenon, it is clear that, as it accompanied a flash of lightning, it was not the fireball familiar to the astronomer but a case of ball lightning. Mr. John Don, of 1 Gardenrose Path, Maybole, Ayrshire, who directed our attention to the above article and who also saw the ball, says that it fell very quickly. Ball lightning, it may be recalled, was photographed before the War on at least one occasion, and was included by Sir George Simpson, former director of the Meteorological Office, in his studies of atmospheric electricity.

White Dwarf Binaries

The April issue of *Sky and Telescope* contains a short notice of white dwarfs which form binary systems, the first discovery being made recently by Dr. W. J. Luyten. The twins were found in Antlia and are of magnitude 14, nearly identical in colour, and apparently genuine members of the dwarf species. Originally a wide double star had been announced, but on examining the star with the 36-in. Steward Observatory reflector, Dr. Luyten found that the fainter component of the wide pair was merely an optical companion, but the brighter component appeared elongated. Verification of the double character of the star was obtained from Mount Wilson, where Dr. Walter Baade secured a photograph with the 100-in. telescope which revealed two stars separated by $3''$ and differing by 0·3 magnitude. A tentative estimation of their orbit shows a period of the order of 250 years, and it is hoped that in ten years the period will be determinable with a fair precision. It is conjectured that the twins are each intrinsically 1,600 times less luminous than the sun and have diameters smaller than that of the earth. Assuming that their masses are typical—about that of the sun—their densities are about 25 tons per cubic inch, or more than $1\frac{1}{2}$ million times the density of water.

Department of Forestry, University of Oxford

The following appointments have been made in the Department of Forestry of the University of Oxford: Dr. W. R. Handley has been appointed microbiologist. He graduated in botany at the University of Leeds in 1935 and was awarded the Ph.D. for his studies on the structure, development and physiology of the xylem of trees. He then turned to bacteriology as research assistant to Dr. F. C. Happold, and in 1939 was appointed lecturer in that subject at the University of Birmingham. During the War he has been working at a public health laboratory at Wellington (Salop) and Hereford. Dr. L. Leyton, who has been appointed tree physiologist, also graduated in botany at Leeds (in 1938) and continued his studies as a University research scholar, working on the physiology of the monocotyledonous leaf, obtaining his Ph.D. in 1941; he has been at the Telecommunication Research Establishment during the War. Squad.-Leader G. W. Dimbleby has been appointed ecologist; he graduated in botany at Oxford in 1939, and has worked on oxidation-reduction potentials as measures of soil activity. It is intended that the work associated with these appointments shall be focused on the relations between tree-growth and soil factors.

Announcements

After evacuation for a period of three years to Saratov, the Leningrad Society of Naturalists has resumed its activities at the State University of Leningrad. Several meetings, general and sectional (zoology, botany, physiology and geology), were held during last spring, and publication of the *Travaux* is also being started.

A new series of lectures on "How it Works in Photography" has been arranged by the Scientific and Technical Group of the Royal Photographic Society of Great Britain to be held at 16 Prince's Gate, London, S.W.7. The first of the series, entitled "Camera and Optics", will be delivered by Dr. G. B. Harrison on September 25 at 6 p.m.

Catalogue 10 recently issued by Schuman's, 20 East 70th Street, New York, contains more than 350 items of old medical and scientific works of the sixteenth and seventeenth centuries. Special mention should be made of works by Boyle, Harvey and Willis, of whom contemporary portraits are inserted. Among many other books deserving attention are: John Banister's "Historie of Man" (1578); Wordsworth's copy of Sir Thomas Browne's "Urn Zurial" and other works; William Clowes' "On the Working Gallilus" (1683); Culpeper's "Physical Directory" (1651); Sir Thomas Elyot's "Castel of Helth" (1541); William Gilbert's "De Magnete" (1600); Peter Levens's "Right Profitable Book for all Diseases. Called the Pathway to Health" (1582); Peter Lowe's "Discourse of the Whole Art of Chyrurgerie" (1634); and Morton's "Phthisiologia or A Treatise of Consumptions" (1694). Frontispieces of many of the works are inserted.

Errata. In the article by Dr. Julian Huxley on "Evolutionary Biology and Related Subjects" in the series dealing with Science in the U.S.S.R. (*Nature*, September 1), on p. 255, col. 1, line 41, for "Khostova" read "Khvostova", and on p. 256, col. 1, lines 26–29, it is stated that "The most interesting are in black-cock, where more than 200 million specimens from the markets for some four hundred years had been gone through". For "four hundred years" read "forty years".

LETTERS TO THE EDITORS

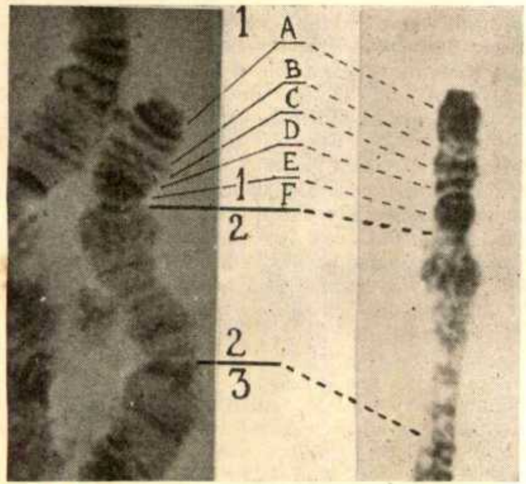
The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Phosphatase on Chromosomes

WHEN the tissues of Craniata are treated by the technique of Takamatsu[1] and of Gomorri[2], alkaline phosphatase is found to be present in the cell nuclei. Willmer[3] has observed that in mitosis in tissue cultures the nuclear phosphatase is concentrated on the chromosomes. One of us (J. F. D.), in collaboration with Dr. H. B. Fell, has found phosphatase on the chromosomes in tissue culture mitoses, and in the mitoses of healing wounds. That the enzyme is indeed in the cell nuclei may be shown in many ways[4]; for example, on heating dry rat kidney sections phosphatase not in the nuclei is destroyed more rapidly than is nuclear phosphatase, so that, by careful timing, sections may be obtained in which only the nuclei contain active phosphatase.

In view of these observations, we thought it desirable to study the distribution of phosphatase on the giant salivary chromosomes of *Drosophila*. Larval salivary glands were fixed in 1 or 5 per cent acetic acid for a few (1–4) minutes, squashed, and the squashes immersed at once in 95 per cent alcohol. The cover slips were lifted immediately to check destruction of phosphatase, which may be caused by prolonged contact with acetic acid. These squashes were then treated by the technique of Takamatsu and Gomorri: this showed the phosphatase to be distributed apparently in bands.

While the phosphatase appears to be situated at the Feulgen positive bands, the amount of phosphatase at any place as judged by the intensity of blackening is not absolutely related to the amount of nucleic acid at the same place, as judged by the intensity of staining shown by acetocarmine preparations. Thus in the case of the left (distal) end of the long arm of the *X*-chromosome, the photomicrographs reproduced herewith will demonstrate the similarities and differences. Taking the acetocarmine staining of the bands as a standard, it appears that 1 *C* and *D* are relatively stronger, while 1 *B* 1–3 are somewhat weaker. The normally dark bands of 1 *E* and *F* are also somewhat weaker and appear to be surrounded by a diffuse cloud of blackening. These differences in relative staining make the identification of the parts of individual chromosomes by means of the standard maps a somewhat precarious proceeding. Nevertheless, the phosphatase bands do give a general pattern strikingly similar on the whole to the more familiar carmine-stained preparation.



(*a*) (*b*)

PHOTOMICROGRAPHS OF LEFT END OF *X*-CHROMOSOME IN SALIVARY GLANDS OF FEMALE *Drosophila melanogaster* LARVÆ: (*a*) STAINED IN ACETOCARMINE, (*b*) STAINED BY TECHNIQUE OF TAKAMATSU AND OF GOMORRI TO SHOW ALKALINE PHOSPHATASE. THE PARTS OF THE CHROMOSOMES ARE NUMBERED AND LETTERED IN ACCORDANCE WITH BRIDGES' (1938) STANDARD *X*-CHROMOSOME MAP.

This apparent coincidence between sites of enzyme activity and of genetic activity suggests that we have here an indication of a process whereby genes influence cellular activity, and is, we believe, the first experimental indication of the nature of such processes.

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Department of Botany,
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[1] Takamatsu, *Trans. Soc. Path. Japan*, **29**, 492 (1939).

[2] Gomorri, *Proc. Soc. Exp. Biol. and Med.*, **42**, 23 (1939).

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Pigments and Chromatophore Reactions of *Polycelis nigra* and *Planaria lugubris*

IN 1938, I observed that the chromatophores of *Planaria lugubris* and *Polycelis nigra* expand in light and contract in darkness. My experiments have recently been repeated with similar results; and in addition the effects of adrenaline and ergotine have been noted. In every case the chromatophores showed normal primary responses (as do the chromatophores of less primitive animals, for example, leeches[1] and sea urchins[2]). They had no influence upon the general coloration of the animals.

Variations in colour appear among Triclads of the same species living side by side. For example, two black, five dark brown, four light brown or grey, five pinkish and one almost white specimens of *Polycelis nigra* have been found underneath a single stone. These variations are due to different depositions of melanin in the skin.

Two typical habitats were selected: one under stones in a slow-running stream (Vicar's Brook) from chalk springs to fen; the other in the axils of leaves of *Glyceria aquatica* in a creek of the Cam (by Fen Causeway). Counts were made in each habitat, care being taken to remove every animal from each stone or plant investigated.

	Under stones		In the axils of leaves			
	P. nigra		*P. lugubris*		*P. nigra*	
	No.	per cent	No.	per cent	No.	per cent
Black	61	15·5	—	—	1	0·7
Dark brown and dark grey	175	44·5	45	67·0	18	12·0
Light brown and light grey	123	31·0	22	33·0	115	78·5
Pink	32	8·0	—	—	11	7·5
White	4	1·0	—	—	2	1·3

From these results it can be seen that the average colour of *Polycelis nigra* and *Planaria lugubris* living in the axils of the leaves of *Glyceria aquatica* (a relatively light habitat) is lighter than that of animals living under stones (a dark habitat) where there is a much greater colour-range. *Planaria lugubris* tends to be darker than *Polycelis nigra* living in the same habitat. The temperature of the water was taken on a number of occasions and varied between 7° C. and 17·5° C. but was consistently the same in the two habitats.

By means of controlled habitat experiments I have shown that colour depends neither upon light nor temperature. No breeding experiments have yet been made to determine whether coloration is hereditary.

I am indebted to Dr. J. E. Smith and Dr. F. G. W. Knowles for much helpful advice.

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June 6.

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[1] Wells, G. P., *Nature*, **129**, 686 (1932).

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Production of Extracellular Starch in Cultures of Capsulated Yeasts

IN the course of a study of the growth requirements of different yeasts, it was unexpectedly found that cultures of *Torulopsis rotundata* gave a steel-blue colour reaction with iodine. The cells of this yeast were grown in a simple inorganic salt medium with glucose as source of carbon, ammonium sulphate as the source of nitrogen and a supplement of thiamine as a growth factor.

The substance responsible for the colour reaction was found to be present in the medium as well as in the large capsules by which cells of this species are usually surrounded, but could not be detected within the cells. It was precipitated from the cell-freed medium by alcohol in the form of white thread-like masses. Several grams were prepared in this way, and after purification the following properties could be demonstrated: the substance dissolves slightly in cold water giving a colloidal and opalescent solution. Molisch test was positive, protein test negative. Treatment with hot 60 per cent potassium hydroxide did not impair the iodine colour reaction. A spectrophotometric analysis of the iodine complex revealed an extinction curve identical with an iodine preparation of pure potato amylose. Acid hydrolysis produced reducing sugar. The solution was practically free from nitrogen. Reactions for ketoses, uronic acids and methyl pentoses were all negative. The fermentation test of the hydrolysed material with bakers' yeast showed that only about 50 per cent of the reducing sugar, calculated as glucose, is fermentable. The unfermented residue gave a strong reaction for pentose. Amylases of plant and animal origin caused complete disappearance of the iodine colour reaction with simultaneous liberation of reducing sugar which, calculated as maltose, corresponded to about 30 per cent of the total weight. The fraction precipitated with alcohol after the action of amylase gave strongly positive reactions for pentose.

These results seem to justify the assumption that the material contains at least two different polysaccharides one of which corresponds to the amylose fraction of the starch of green plants, the other being a pentosan.

A great variety of carbon compounds other than glucose including aldo- and keto-hexoses, disaccharides, pentoses, methyl-pentose (rhamnose), polyalcohols and organic acids permitted growth of the yeast in the synthetic medium with simultaneous production of the amylose fraction. Cori ester and polysaccharides (inulin, starch, glycogen) were unsuitable sources of carbon for growth and failed to maintain amylose production even when a heavy inoculum of cells was used. On the other hand, not all sources of nitrogen used by the yeast enabled the formation of amylose. If, for example, the yeast is grown in a medium with either peptone, urea or potassium nitrate instead of ammonium sulphate, an extracellular polysaccharide is produced which gives a positive test for pentose but is entirely free from amylose. It can be demonstrated, however, that the production of the amylose does not depend in principle on the nature of the nitrogen compound but on the *p*H which is established during the utilization of nitrogen by the micro-organism. Amylose formation was observed only if the reaction was below *p*H 5. If the yeast is grown with ammonium sulphate or chloride as sole source of nitrogen, a steady lowering of the *p*H occurs as the sulphate or chloride ion is set free, whereas with potassium nitrate, urea and peptone an alkalinization results. Correspondingly, when calcium carbonate is added to the ammonium sulphate medium, the formation of amylose is suppressed; whereas the buffering of the reaction at a *p*H below 5 leads to a production of amylose even in a medium containing peptone as sole nitrogen source. In conclusion, it may be said that production of amylose by *T. rotundata* only takes place if the medium is favourable to good growth and maintains during growth a reaction below *p*H 5.

Twenty-five different yeast strains belonging to various taxonomic groups, *Saccharomyces*, *Schizosaccharomyces*, *Hansenia*, *Willia*, *Monilia*, *Rhodotorula*, *Torulopsis* (uncapsulated), produced no amylose when tested in the conditions defined above. Among the capsulated *Torulopsis* yeasts, the only species other than *T. rotundata* available to us was the pathogenic *T. neoformans*, also known in the medical literature under the synonyms of *T. histolytica* or *Cryptococcus hominis*. This strain produced amylose in exactly the same conditions as *T. rotundata*.

The serological properties of the extracellular polysaccharides described above are at present under investigation.

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Antibiotics from Moulds

THE antibiotic for which the structure anhydro-3-hydroxymethylene-tetrahydro-γ-pyrone-2-carboxylic acid has been proposed[1] was detected in the metabolism solution of *Aspergillus clavatus*[2] (clavacin)[3], was isolated in crystalline form from *Penicillium claviforme* (claviformin)[4], *P. patulum* (patulin)[1] and *A. clavatus* (clavatin)[5]. The chemical nature of the product was investigated[1,5] and the structure given above was proposed[1]. The product has also been isolated from the metabolism solution of *P. expansum*[6], *A. giganteus*[7], *P. melinii*[8] and *Gymnoascus* sp.[9].

We have now shown that the same substance is responsible for at least part of the antibiotic activity reported[9,10,11] as being produced by the following moulds: *Penicillium urticæ* Bain. (N.C.T.C. No. 1215); *Aspergillus terreus* Thom (N.C.T.C. No. 981); *Penicillium expansum* (Link) Thom (N.C.T.C. No. 5612). (The production of this inhibitor by a number of unspecified strains of *P. expansum* was reported[6] two years ago.)

In each case the substance was isolated from the crude culture fluid by adsorption on charcoal, elution with 80 per cent acetone, and extraction of the concentrated acetone-free eluate with ether in a liquid-liquid extractor for several hours. Crude crystalline inhibitor separated from the concentrated ether after 1–2 days in the refrigerator and was recrystallized from hot chloroform. Identity with the authentic substance was established by mixed melting point, analytical figures, *p*H stability, antibacterial properties and chemical tests.

All three moulds were grown on liquid media in layers 1–2 cm. deep, at 24° C. for 6–10 days; antibiotic action was shown on a number of media by each mould, but the particular media from which the inhibitor was actually isolated were: *P. urticæ*, Czapek-Dox; *A. terreus*, Czapek-Dox, also 2 per cent malt extract; *P. expansum*, potato-dextrose. In the case of *A. terreus* some other inhibitor is produced under certain conditions. This is being studied.

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University of Oxford.
June 8.

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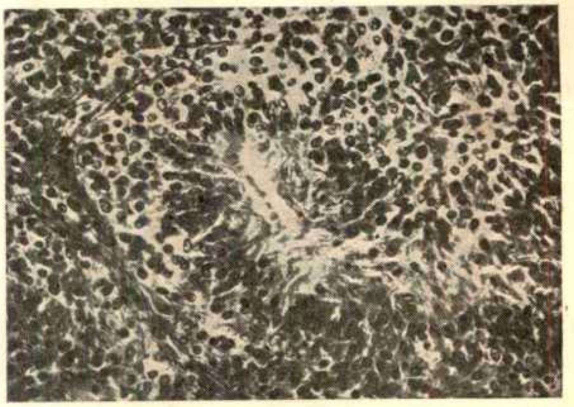
Glioma in a Rat Fed with 2-Acetyl-amino-fluorene

MALIGNANT tumours of nerve tissue have been produced experimentally in mice of pure strains by several authors. In rats, repeated unsuccessful attempts have been reported; but Russell[1] has recently given convincing evidence of positive results. All successful results have been achieved by direct action of the carcinogenic hydrocarbons (mainly methylcholanthrene) upon the nerve tissue, by way of crystals or pellets implanted in the brain substance. The result reported below refers to glioma-induction in a rat by the oral administration of a new carcinogenic agent, 2-acetyl-amino-fluorene.

The carcinogenic activity of 2-acetyl-amino-fluorene was discovered by Wilson *et al.*[2] and has been investigated in Great Britain by Bielchowsky[3], to whom we are indebted for a generous supply of the substance. The interesting feature of its action is the variety and multiplicity of the neoplasms provoked by oral administration.

The rat which developed a glioma was one of twelve which were fed from the age of two months for twenty-four weeks on a standard diet in which was incorporated 0·5 gm. of the substance in 1 kilo of food. Of the twelve rats, seven are still alive and well. Four have developed tumours; study of the fifth is not yet complete. Of the four which had tumours, one had a malignant hepatoma; another a mammary cancer and an auricular epithelioma; a third, a mammary cancer, two epitheliomas of the ductus acusticus and a hepatoma; the fourth, the subject of this note, a glioma.

The rat with the glioma first gave signs of a brain tumour by inco-ordination of movement and by a slight paresis. Two weeks after these signs were noticed, the animal died. At the post-mortem examination the only abnormality present was the asymmetry of the cerebral hemispheres, with the left obviously and regularly enlarged in its frontal part. The enlargement was accompanied by a loss of the normal aspect and vascularity of the cerebral surface. Sectioned after fixation, the left hemisphere showed the existence of a voluminous infiltrating tumour mass extending throughout the olfactory bulbs, which were later found to be totally invaded by the new growth, and the white matter of the frontal and temporal lobes, gradually diminishing backwards and leaving the cortex almost intact. The anterior and main parts of the lateral ventricle were filled with tumour tissue but the posterior horn was patent. At the level of the olfactory bulb and part of the frontal lobe the tumour invaded the leptomeninges, spreading along the subarachnoidal spaces to the cortex of the left and right sides by way of the perivascular spaces.



Microscopically, the tumour shows an almost uniform mass of small cells, mostly with round nuclei and short elongated cytoplasm. In some parts the cells are arranged in 'rosette' or palisade fashion with converging processes as shown in the accompanying illustration. Some mitoses are present. There are few blood vessels but no necrotic zones. These characteristics lead to the diagnosis of the tumour as a glioma belonging to the type 'glioblastoma isomorphe' according to the Rio-Hortega[4] classification. Further structural details will be published later.

The extraordinary rarity of spontaneous gliomas in the rat and the time of the appearance of the tumour, simultaneously with the other tumours in the series, justifies the opinion that this is a chemically induced neoplasm. The small number of animals used does not permit of any conclusion about the relative incidence of this type of tumour among the many produced by the same agent. With regard to previous experiments on glioma formation, it seems evident that when the carcinogenic substance is administered, as in our case, by a systemic route, the pathogenesis of the tumour must be nearer the natural glioma development than if a massive amount of the agent is artificially brought into direct contact with normal cerebral tissues.

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Penicillin in Kala Azar

In the available literature to date there appears to be no record of the effect of penicillin in leishmaniasis, and as a supply of the drug has recently become available it was decided to try its action on two cases of kala azar. Both cases were regarded as clinically typical and fairly severe, and neither had previously received any kind of treatment. The following short notes illustrate the patients' conditions before and after treatment.

Case (1). Male, twenty-two years, admitted to Gedaref Hospital on 2.5.45 seriously ill with a history of seven days fever (his condition suggested he had been ill for a much longer period), and clinical dysentery.

Clinical Notes : Spleen 1 F.B. (finger's breadth below costal margin). Liver 3 F.B. Spleen and lymphatic gland smears positive for *Leishmania donovani.*
Blood Count : R.B.C., 3,000,000 ; W.B.C., 3,000. Diff. count, P 57, L 31, L.M. 12 E.O. Repeated blood films negative for malaria and other parasites.
Fæces contained blood and mucus ; no *Entamœbæ histolytica* were found. Urine normal.

After some days rest and treatment for bacillary dysentery his condition improved considerably. Penicillin treatment commenced on 21.5.45 and continued until 29.5.45. During treatment he developed an attack of malaria, and M.T. parasites were present in blood (23.5.45). The malaria was controlled by quinine. The temperature chart was complicated by the malaria, but when this was treated the temperature still continued swinging with no sign of diminution (ranging from subnormal to 104° F.). Liver and spleen were unaltered and there was no sign of clinical improvement. On 31.5.45, spleen and gland smears still positive.

Case (2). Female, aged forty, admitted on 14.5.45 complaining of fever for one month.

Clinical Notes : General condition, fair. Spleen, 3 F.B. Liver, 1 F.B. Spleen and gland smears, positive for *Leishmania donovani.*
Blood Count : R.B.C., 3,400,000 ; W.B.C., 4,000. Diff. count, P 65. Lymph 29. L.M. 6 E.O.
Repeated blood films negative for malaria or other parasites.
Fæces and urine normal.

Treatment commenced on 21.5.45 and continued until 29.5.45. During treatment the temperature showed no signs of diminution, ranging between normal and 104° F., and the general condition appeared to be deteriorating. There was no appreciable change in the blood counts and no diminution in size of the spleen and liver. On 31.5.45 spleen and gland smears still positive.

Treatment : 20,000 units of penicillin in normal saline (4 c.c.) were given intramuscularly three-hourly until a total of 1,500,000 units was reached. There were no complaints of pain or reaction. To avoid any mistake in times of administration or dosage, all injections were given personally by one of us (M. H. S.), the course of treatment, dosage and times of administration being identical for both patients.

Comments : The results were a complete failure, and there was no evidence that the course of the disease in either patient was influenced in any way. On the contrary, the condition of the second patient deteriorated, while the first patient developed malaria during the course.

It is of course well known that Sudan kala azar, as compared to the Indian disease, is far more resistant to any kind of drug, and the possibility must be admitted that much larger doses with continuous administration might have had some influence on the course of the disease. At the moment, it can only be said thay there is no evidence in favour of such a suggestion, and either repeated or continuous administration has serious disadvantages when treatment has to be carried out in a small hospital without a specially trained staff.

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A Medium for Mounting Parasitic Helminths

This medium is an aqueous one, and gum arabic forms its basal element. It is clear and of a suitable refractive index for mounting stained helminthic parasites. Carmine-stained specimens mounted in this medium show no deterioration or discoloration. Above all, the medium has great tolerance of water ; in fact, no dehydration and clearing is required before mounting specimens in it.

Chemicals : Hung's Solution I*		
	Gum arabic	8 gm.
	Distilled water	20 c.c.
	Chloral hydrate	80 gm.
	Glycerine	12 c.c.
Hung's Solution II*		
	Gum arabic	20 gm.
	Distilled water	20 c.c.
	Chloral hydrate	17 gm.
	Glycerine	3 c.c.

* Dedicated to Dr. See-lu Hung, under whose guidance this medium was worked out.

In preparing the solutions, the gum arabic is first dissolved in the distilled water, then the other chemicals are added in the order given.

Procedure : The helminth is fixed and stained in the usual way. Having been destained, the material is washed in 70 per cent alcohol or in distilled water. Then it is transferred directly into solution I for one to two hours according to the size of the specimen ; material remaining in the solution I is not injured. Finally it is mounted in solution II. Within two days, the mounting medium surrounding the margin of cover glass becomes solidified, and in two weeks it becomes quite hardened.

Some worms, such as *Fasciola hepatica, Fasciolopsis buski, Echinostoma revolutum, Clonorchis sinensis, Metagonimus yokogawai, Echinococcus granulosus, Dipylidium caninum, Diphyllobothrium mansoni, Taenia crassicollis, Taenia solium, Ancylostoma duodenale, Necator americanus, Enterobius vermicularis* have been mounted satisfactorily in this medium.

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THIS interesting communication directs attention to the great difficulty experienced by most workers in making really satisfactory and permanent preparations of nematodes. The Hung's solution described above resembles in composition Berlese's well-known medium for mounting small insects and small arachnids. The formula of this is given by Bolles Lee[1], as follows: Water 20 c.c., chloral hydrate up to 160 gm., gum arabic 15 gm., glucose syrup 10 c.c., acetic acid 5 c.c. On the same page Bolles Lee gives the following formula which is, it is stated, used in British and other museums (its origin is unknown): distilled water 50 c.c., gum arabic 40 gm., glycerin 20 c.c., chloral hydrate 50 gm. Dr. P. Tate of the Molteno Institute, Cambridge, reminds me that formulæ for other gum-chloral media exist, some of which contain cocaine hydrochloride, presumably put in to narcotize living small insects and arachnids. An example of these is the medium of G. Faure[2] mentioned by M. Langeron[3], who gives the following formula for it: distilled water 50 c.c., gum arabic 30 gm., chloral hydrate 50 gm., glycerin 20 c.c., 0·5 gm. cocaine hydrochloride being added when living animals are being mounted. References to methods used for the mounting of nematodes parasitic in plants will be found in "Plant Parasitic Nematodes", by T. Goodey (Methuen, London).

A gum-chloral medium is used by H. L. Ratcliffe[4] for the mounting of adult nematodes (hookworms and small nematodes) and the eggs of *Enterobius vermicularis*. A concentrated suspension of the eggs of this species in neutral formalin is passed through a series of bottles containing dilutions of gum-chloral in 10 per cent formalin, beginning with a 10 per cent dilution and rising by 2 per cent increases in strength until the eggs are suspended in pure gum-chloral. The process takes two months. Ratcliffe recommends it also for insects (including their larvæ and pupæ) and small arachnids.

D. Minckler[5] gives a method for clearing, in less than three days, adult *Enterobius vermicularis* for class study. The nematodes are fixed in 10 per cent formalin and the formalin is washed out for several hours in running water. The nematodes are then put in three changes of dioxane, each change lasting one hour. They are then put in carboxylene (phenol 25 c.c., xylene 75 c.c.) for twenty-four hours and then three changes of neutral xylene lasting a few minutes each, and mounted in damar dissolved in xylene. The nematodes are handled in a small bottle, the fluids being decanted. They adhere to the sides of the bottle, so that this is drained after each change by setting it mouth downwards upon filter paper. The nematodes are removed for final mounting by a large-calibre medicine dropper. The nematodes acquire a tan or yellow colour in various parts, but the nerve ring is not shown.

T. N. Tahmisian[6] gives a method for mounting hookworms without the opacity which is usually experienced when they are put into balsam. This has been attributed, he says, to imperfect dehydration and to exposure to air between clearing and mounting, but shows that this is not so. When he dehydrated carefully and cleared in xylene or toluene and then floated balsam over the clearing oil to prevent the access of air, 90 per cent of the nematodes were still opaque. He noted that those which cleared were always ruptured ones. He therefore partially dehydrated them in 70 per cent alcohol and then pierced the cuticle with a fine needle under the dissecting microscope. The nematodes were then further dehydrated, cleared and mounted without difficulty. He says that, when the cuticles of opaque nematodes were pierced, gas could always be expressed from them and that then they would clear. He believes that the balsam causes a rapid exosmosis of the clearing oil, so that gas forms under the cuticle and causes opacity.

There are, of course, other methods of mounting nematodes, such as treatment of them with lactophenol (see Bolles Lee, "Microtomist's Vademecum"). This is very useful for diagnosis, but preparations cleared with it are not suitable for permanent use. It seems probable that work now being done in Cambridge by Dr. Trim and at Newcastle by Prof. A. T. Hobson on the permeability of the nematode cuticle may eventually indicate methods of preliminary treatment of the nematode cuticle which will make permanent preparations of them much more satisfactory. Meanwhile it would be valuable to know of other methods which individual workers may have found satisfactory for making permanent preparations of either trematodes, cestodes or nematodes.

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Production of Skin Burns by Hot Gases

THE chief factor determining the time taken to produce a burn of given severity will be the rate of heat transfer from the hot gases to the skin. Other factors such as individual variation in the skin and its condition at the time, for example, sweating, will also play their part. Thermal conduction from the skin surface into the deeper tissues is a complex phenomenon, but a simplified model leads to interesting conclusions.

If we treat the corium as a single region of reasonably uniform temperature from which heat is conducted away into the deeper tissues, that is, across or through the fatty layer when present, at a rate proportional to the elevation of its own temperature, then $d\theta/dt = Q/\rho l s - A\theta$, where Q is the rate at which heat is transferred across the epidermis into the corium from the hot gases, θ is the rise of temperature (above normal) in the corium the thickness of which is l, density ρ and specific heat s; t is the time and A a constant.

Integrating and putting $\theta = 0$ when $t = 0$,

$$t = -\frac{2\cdot30}{A}\log_{10}(1 - A\theta\rho ls/Q),$$

treating Q as a constant independent of θ, which will be justifiable while θ and the temperature difference across the epidermis are small compared with the difference between the temperature of the hot gases and skin temperature.

If a temperature rise of θ' in the corium is necessary to produce a burn of given severity, then Q must exceed $A\theta'\rho ls$ or no such burn can be produced. The total absorbed heat, H, required to produce the burn is Qt', which has a minimum value of $\theta'\rho ls$ when Q is very large.

According to recent work[1], a temperature of about 50° C. must be reached in the corium if irreversible effects leading to œdema and scabbing, that is, second-degree burns, are to occur. This corresponds to a value of θ' for such burns of about 15° C. The thickness of the corium is variable, but 1–2 mm. is average, the ventral surfaces being the thinner. Both the density and specific heat may be taken as approximately unity. Hence for burns of the ventral surface of the forearm, the value of the factor $\theta'\rho ls$ should be about 1·5.

Gas temperature (° C.)	Velocity of flow (ft.p.m.)	Q* (Cal./sec./cm.^{2})	Efficiency of thermal transfer (per cent)	H (cal./cm.^{2})		t' (sec.)	
				obs.	calc.	obs.	calc,
150†	25	0·10	35	>6	–	>60	–
200†	25	0·133	35	2·5	2·7	15–20	20
1100‡	1000	3·6	9	1·4	1·5	0·4	0·44

* Measured by the rate of temperature rise of a copper block when in similar position as the forearm. This assumes the surface coefficient to be similar for skin and metal at similar temperatures. That the epidermis is a poor conductor does not significantly affect this assumption, since its thermal capacity is negligible, and the temperature differences across it necessary to produce these rates of heat transfer are small compared with the differences of temperature between the hot gases and the skin. Under other conditions, for example, burning by contact with relatively low-temperature objects, the conductivity of the epidermis may become of major importance.

† From 1 cm. diam. jet.

‡ Large flame.

The data in the accompanying table represent a small group of nine second-degree burns of the ventral surface of the forearm of three subjects; the burnt area was about 2 cm. in diameter in each case. No burns were produced when Q was less than 0·10 cal./sec./cm.^{2}:

that is, $A\theta'\rho ls \simeq 0\cdot10$ and $A \simeq 0\cdot067$.

Hence the time taken under these conditions to produce a second-degree burn,

$$t' = 34\log_{10}\left(\frac{Q}{Q - 0\cdot10}\right).$$

The calculated values of H and t' in the table are derived from this equation and are in good agreement with the experimental figures.

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May 28.

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Absolute and Differential Light Sensitivity of the Dark-adapting Eye

THE lack of correlation between the absolute light threshold of the dark-adapted eye and the 'ability to see in the dark' has been currently attributed to psychological factors; but little attention has been given to the behaviour of contrast sensitivity, despite the fact that vision at low illumination depends largely on the perception of differences in brightness. In particular, the possibility of variations in contrast sensitivity independent of variations in the absolute threshold does not seem to have been investigated, although the occurrence of such variations seems likely from the observations of Edmund and others[1,2].

Comparison also of the generally disappointing data on variations in the absolute light threshold of the dark-adapted eye in supposedly vitamin A deficient and non-deficient (or treated) subjects with the data on variations in contrast sensitivity as observed by the Scandinavian workers[1,2], suggests that the latter yield more significant differences. However, no reference directly relating the two functions, or adequate data allowing of direct comparison, could be found in the literature.

We have carried out a comparative study of the absolute and differential threshold of the dark-adapting eye in selected subjects with 'good' and 'poor' night vision respectively, and our observations indicate first, that, in observers with identical light-threshold recovery curves, marked differences in contrast sensitivity occur, and appear to be related to their 'ability to see in the dark'; secondly, treatment of the 'poor' observer with vitamin A together with brewers' yeast produced a striking improvement in contrast sensitivity with little effect on the light threshold.

The instrument used was the new Crookes's standard adaptometer[3], the only modification being that the test object was replaced by black or grey arrows on a fully transparent background. The curves shown here were obtained, after initial light adaptation to 750 ml. for five minutes, by recording the time required in the dark to recognize the position of a rotatable grey or black arrow on a bright ground, the brightness of which was reduced in steps. The following contrasts were used: C_1, 7 per cent; C_2, 20 per cent; C_3, 34 per cent; and C_4, 100 per cent. A curve thus obtained with a 'black' figure on a bright ground is practically identical with one obtained using a bright figure on a black ground and, with a relatively large and simple figure, is closely approximate to the recovery of the absolute light threshold. A simple figure was chosen as it objectivates the response and appears to control the part of the retina used. A remarkable reproductibility was obtained without a fixation spot[3,4]. There was thus freedom for using the most suitable part of the retina, which was parafoveal for the lower rod range; the observer was advised to facilitate perception of contrast by continuous small movements of the eye. Observation was binocular with natural pupils, the distance between eye and test object being 60 cm., the test field and the smallest detail of the arrow having a visual angle of 7° and 1° respectively. The curves representing the visibility of the lower contrasts are averaged from repeated tests, their number being indicated in brackets. (These curves describe the outer envelope of adaptation curves which are not smooth, but actually fluctuate.)

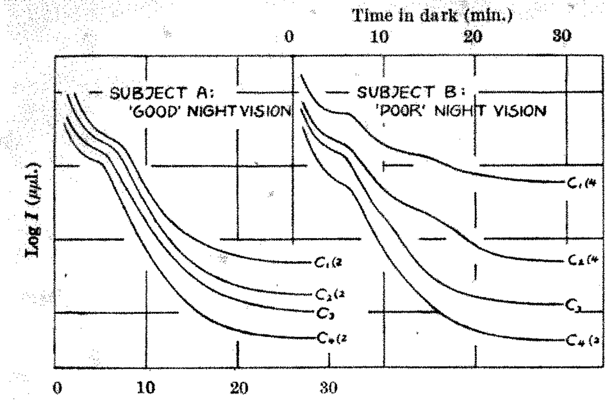

Fig. 1. RECOVERY OF CONTRAST SENSITIVITY IN TWO SUBJECTS WITH 'GOOD' AND 'POOR' VISION RESPECTIVELY.

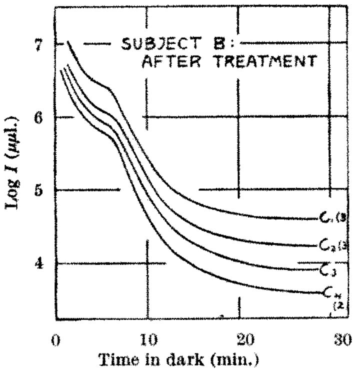

Fig. 2. SUBJECT B. FOLLOWING TREATMENT.

Fig. 1 shows a typical set of observations. Fig. 2 shows the changes in the 'poor' observer following treatment for 10–14 days, consisting of daily administration of 33,000 I.U. of vitamin A (Crookes's vitamin A concentrate) and about 10 grams of dried brewers' yeast ('Aluzyme') kindly supplied by Messrs. Phillips Yeast Products, Ltd. A second dose of vitamin A was given on the day of the tests 3–7 hours before the test.

Psychological factors undoubtedly play a part in night visual capacity[5,6]; however, complaints about poor night vision in subjects having a normal absolute light threshold should not be tacitly attributed to such factors without information concerning contrast sensitivity. It also seems likely that the latter may reflect more sensitively the influence of nutritional, metabolic and presumably also nervous factors than variations in the light threshold. It may, in fact, under the experimental conditions herein described, represent the only demonstrable change in visual sensitivity.

Our thanks are due to Messrs. Crookes Laboratories for the loan of the adaptometer, to Mr. R. B. Morris from Kodak Research Laboratory for help and advice, and to Mr. A. Rugg-Gunn for his stimulating interest.

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Parthenocarpic Production of Tomato Fruits

RECENT work at Long Ashton has shown that a number of chemical compounds, when suitably applied, will induce the parthenocarpic production of tomato fruits[1]. Their effectiveness has varied between 2-4 dichlorophenoxy acetic acid which can be used at 1 p.p.m., to that of *beta* naphthoxyacetic acid which is used at 60 p.p.m. The use of the latter substance on a commercial basis is now possible, and I have used it in commercial greenhouses in 1945 to 'set' bottom trusses which had failed owing to unusual weather conditions. In one instance a natural set of 25 per cent was raised to 97 per cent by a single application.

Many of these substances, however, have marked 'formative effects' when used at relatively high concentrations[1], and a number of symptoms suggestive of virus diseases have been induced in this way[1,2]. This property is now being used in extreme measure in the so-called selective weed killers[3,4,5].

Two completely new lines of investigation have recently been opened up in experiments at Long Ashton to induce parthenocarpy in tomatoes. The first is in the use of synthetic animal hormones of the œstrogen type, the second in the use of crude extracts of tomato flowers.

Recent developments in animal hormone physiology have shown that certain substituted stilbene compounds are more effective œstrogens then the naturally occurring substance. Preliminary trials on tomato have shown that 4-4′ dihydroxydiethyl stilbene (stilbœstrol) will cause parthenocarpic development of tomato fruits within the concentration range 50–100 p.p.m. Hexœstrol, which is the hydrogenated stilbœstrol, has also been shown to be active in this direction. These observations are of considerable theoretical interest since the latter substance is a fully saturated compound and does not contain a carboxyl group. By further substitutions within this molecule, it may be possible to provide a chemical theory for some of the work now in progress.

The second line of development is no less important. During this work large numbers of tomato flowers were removed just prior to anthesis. These were stored in the laboratory in a litre beaker until it was nearly full. These flowers were then extracted with ether under a reflux condenser. The dried ether extract was taken up with 5 ml. of absolute alcohol and diluted to 100 ml. with water, when a dense cloudy suspension of unknown concentration was obtained. Portions of this suspension were further diluted to ¼ and ½ strengths respectively, thus giving three concentrations. All these proved active when applied to the tomato. 5 ml. of 11 per cent ester salts per litre of water was added to all sprays in order to provide adequate wetting properties. The most concentrated solution induced 100 per cent set when applied to flowers which had been deflorated fourteen days earlier. Appreciable development of the fruits was noticeable three days after application and in this respect the extract of tomato flowers compared favourably with beta naphthoxyacetic acid. A second batch of flowers similarly extracted yielded an extract which was equally active. It is hoped in due course to obtain sufficient material to provide for biochemical investigations of the active substances in the flower extract.

These observations suggest an important field for investigation into problems of fruit setting and development of tree fruits, and may have important applications in orchard practice in relation to problems of pollination and sterility.

In similar experiments with apples and pears, only limited success has so far been achieved. A severe frost occurred on April 30–May 1, 1945, by which time apple and pear fruits had set and commenced to swell. The frost killed the embryos and blackened the centres of the fruits. A number of trees of apple and pear bearing crops of these frosted fruits were sprayed on May 8 with a mixture of growth-promoting substances known to be effective on tomato. Conference pear and Miller's Seedling apple responded to the spray, and at the time of writing all treated fruits are still on the trees and some show appreciable swelling. Cox trees sprayed at the same time with the same mixture did not respond and all the fruits fell off, as was also the case with the untreated trees of Miller's Seedling. It is still doubtful whether the treated fruits of Miller's Seedling will develop to full size or maturity, but it is of interest that such severely damaged fruits have been prevented from falling, and it seems reasonable to expect that in further experiments suitable materials will be found which will be as effective on apples and pears in inducing parthenocarpy as *beta* naphthoxyacetic acid is on tomato.

Grateful acknowledgment is made to Dr. S. J. Folley, of the National Institute for Research in Dairying, and to Messrs. Boots, Ltd., for the synthetic œstrogens used in these experiments.

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Neutron-Proton Scattering at 8·8 and 13 MeV.

THE experimental work of Champion and Powell[1] on neutron-proton scattering at 8·8 and 13 MeV. gives, essentially, two new results: (1) the angular distribution, as given by the best smooth curve, is not exactly isotropic as is generally expected for particles of wave-lengths long compared with the dimensions of the system; (2) there is some evidence for a high-order fluctuation in the intensity.

Champion and Powell suggest (*op. cit.*, p. 84) that the general trend of the distribution can be due to a small p-component in the scattered wave. However, the intervention of forces deriving from potentials of the type

$$S_{12} = ({}^1\vec{\sigma}\vec{r}_{12})\,({}^2\vec{\sigma}\vec{r}_{12})\,.\,f(r_{12}), \quad . \quad . \quad (1)$$

suggested by the existence of the quadrupole electric moment of the ground-state of the deuteron[2], gives rise, already in the lowest-order scattering wave, to a mixture of S and D states, therefore leading—even in the first approximation—to an anisotropic scattering.

Rodrigues Martins[3] has investigated the influence of the coupling (1) on the angular distribution of the triplet (${}^3S + {}^3D$) scattering. Following the general lines of his paper, it can be shown that the angular distribution of the lowest scattering is given by

$$I(\theta) = 1 - 1{\cdot}19\,|C_2| \cos\delta\,.\tfrac{1}{2}(3\cos^2\theta - 1) + f(\theta).|C_2|^2 +, \quad . \quad . \quad (2)$$

where C_2 is the scattering coefficient of the d-wave (taking $C_0 = 1$), and δ is its phase-shift.

Neglecting the quadratic terms, we obtain the general trend of the distribution (referred to the centre of mass of the system); determining the factor $|C_2| \cos\delta$ so that the mean quadratic error with respect to the curves of Champion and Powell be a minimum, we obtain the values $- 0{\cdot}11$ for the 8·8 MeV. neutrons group, and $+ 0{\cdot}14$ for the 13 MeV. group. Drawing the curve, it is seen that the intervention of potentials of the type (1) produces a remarkable anisotropy in the angular distribution. According to the formulæ given by Rodrigues Martins (due to eventual resonance with compound levels), the values of $|C_2|$ are of the order of 1/10 and are thus sufficiently in agreement with the values of $|C_2| \cos\delta$ as obtained above.

On the other hand, the fluctuations suggested by Champion and Powell cannot be explained by the intervention of forces of the type (1). As a matter of fact, the amplitude of these fluctuations exceeds considerably the value of the quadratic terms of (2); and their frequency would require the inclusion of spherical waves of very high order. Therefore, if these fluctuations should be found to be real, it would be hard to explain them by any physical picture.

Supposing, further, that all the forces acting are of the exchange type, the potential (1) would have to be replaced by[4]

$$R_{12} = \tfrac{1}{2}(1 - {}^1\beta\,{}^2\beta)\,({}^1\vec{\alpha}\vec{r}_{12})\,({}^2\vec{\alpha}\vec{r}_{12})\,.\,f(r_{12}) \quad (3)$$

The amplitudes of the scattered waves remain, then, essentially the same as in the foregoing case, at least in Born's approximation.

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April 12.

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Time Dependence of Interfacial Tension and Density in Solutions

DR. A. F. H. Ward and L. Tordai[1] have described experiments showing changes of interfacial tension with time in solutions. There is no mention made whether in these experiments density changes also could be observed.

I have investigated a number of systems in which the interfacial tension changes in time. The most remarkable feature of these experiments was the time dependence of some other properties, and densities in particular. Densities can be easily measured to six decimal places. I observed changes in the third decimal as a rule. Changes in densities were observed irrespective of whether the experiments were conducted uninterruptedly, or portions taken out for individual measurements.

Before equilibrium is reached, the physical properties and densities in particular fluctuate all the time, and eventually they become stabilized and acquire definite values. Similarly, F. F. Nord[2] with collaborators has described volume changes in sodium oleate as a function of time.

These facts cannot be interpreted as surface phenomena, but must be attributed to changes in the bulk of solutions[3].

GEORGE ANTONOFF.

Fordham University,
New York, N.Y.
May 2.

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[1] *Nature*, **154**, 146 (1944).

[2] Nord, F. F., and others, *Ber.*, **65**, 1148 (1932); *Koll. Z.*, **58**, 205 (1932).

[3] Antonoff, G., *Arch. Biochem.*, **6**, 199 (1945).

Occurrence of Boron Phosphate in Fireside Deposit from an Economizer

IN a recent communication in *Nature*, Rafter[1] has directed attention to the presence of appreciable proportions of boron in samples of New Zealand coal ashes.

In this connexion it may be of interest to note the presence of a comparatively large proportion of boron phosphate in a deposit recently examined here. This deposit was one of several typical deposits from the fireside of economizers and boiler tubes of certain high-pressure boiler plants which were examined in 1942 and 1943; the work was carried out at the request of the British Coal Utilisation Research Association acting on behalf of the Boiler Availability Committee sponsored by the Central Electricity Board.

The method of separating deposits taken from the fireside of economizers and boiler tubes into convenient fractions has been suggested by B.C.U.R.A. It is as follows: the sample is powdered, extracted by boiling water, then by 10 per cent aqueous nitric acid and finally the insoluble residue is analysed. The insoluble residue prepared in this way from the deposit removed from an economizer of a high-pressure boiler had the following composition:

SiO_2	50·93%	$K_2O + Na_2O$	1·92%
Fe_2O_3	8·7	$CaO + MgO$	0·82
Al_2O_3	4·16	P_2O_5	17·7
B_2O_3	7·6	SO_3	1·78

Loss on ignition, 8·04 per cent.

There was negligible loss of phosphoric acid when the material was boiled with water or with 10 per cent nitric acid. It was therefore probable that the phosphoric acid was not combined with the metallic oxides. A search was next made into the possibility of its being combined with silica or with boric oxide.

Comparatively stable silicyl phosphates have been prepared[2] and their X-ray powder patterns described[3]; the X-ray powder pattern of the insoluble residue from the economizer deposit did not correspond with that in ref. 3 or with that of the silicyl phosphate which we synthesized by the method given by Hautefeuille and Margottet.

On the other hand, boron phosphate made as described by Vogel[4] gave a pattern corresponding exactly with that produced from the insoluble residue. This pattern agrees with that determined by Schultze[5] and with that set out in the Index of X-Ray Diffraction Patterns published by the American Society for Testing Materials (Card 1301). Boron phosphate is therefore a major constituent of the insoluble residue from the economizer deposit; it amounted to about 4½ per cent of the particular sample of deposit which we examined. Unfortunately, it is not possible to relate this occurrence of boron phosphate to the fuel from which it was derived, because during the time the deposit was being formed, the fuel burned in the grate was drawn from a wide variety of sources.

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Research Department,
Alkali Division,
Northwich, Cheshire.
June 6.

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[1] *Nature*, **155**, 332 (1945).

[2] Hautefeuille and Margottet, *C.R. Acad. Sci.*, **96**, 1052 (1883); **99**, 789 (1884); **102**, 1017 (1886); **104**, 56 (1887).

[3] Levy and Peyronel, *Z. Kryst.*, **92**, 190 (1935).

[4] Vogel, *Z. Chem.*, (2) **6**, 125 (1870). See also Skey, *Chem. News*, **16**, 187 (1867), for the first description of this compound; and Mylius and Meusser, *Ber*, **37**, 397 (1904) for a detailed account.

[5] Schultze, *Z. phys. Chem.*, B, **24**, 215 (1934).

The Hazel Period in the Post-Glacial Development of Forests

POLLEN analysis shows the well-known hazel-maximum, especially in Central and Western Europe. In certain horizons hazel pollen is so frequent that there must have existed real hazel-scrub forests. This hazel period has been assigned to the beginning of the post-glacial warm period, and coincides with the mesolithic culture period (see, for example, Firbas[1]).

The reason for this high frequency of hazel pollen is, according to Firbas, difficult to understand to-day. This is shown too by the interesting attempt of Erdtman[2] to explain the apparent pollen frequency by modalities of sedimentation and preservation of hazel pollen.

Climatic changes, such as those in humidity, should not have been very important, according to Salisbury and Jane's[3] determinations of widths of annual rings.

I would not attempt to suggest a possible explanation for the problem, if I had not observed, during residence in Brazil, the great transformations in vegetation caused by natural or artificial fires. Modern ecology agrees that fires made by primitive man, to free land for the hunter and the cultivator, have swept over very large areas. It is probable that prehistoric man acted in the same way. Fire has a selective action among the plants, according to their capacity to survive it. *Corylus* seems to be fire-resistant. This is emphasized in the very interesting description that E. Chavannes[4] gives for Wisconsin: ". . . Names of a Richwood, Glenwood, Woodland type appear frequently, as do several forest townships in the north and east. Scrub vegetation characteristic of areas undergoing encroachment is described in Hazel Green, a village name referring not to a pioneer's sweetheart, but to a condition commonly found in burned-over woodland. After ground cover and trees were destroyed by recurrent prairie fires, hazel brush sprang up thickly, persisting through the fires by virtue of a sturdy root system, flourishing as a scrub between destructions."

If during the Mesolithic period the same methods of using fire were practised, the existence of such prevalent hazel vegetation would not be unexpected; in any event there is a certain concordance in the maps of the distribution of the hazel maximum in the boreal period, for example, that given by Erdtman for Europe, and the distribution of the Campignien culture period, as generally indicated by prehistorians.

In this connexion it is interesting that hazel in North America is seldom if ever mentioned by authors from that country (for literature see Sears[5]). Detailed studies on the connexion of the hazel period with the prehistoric cultures would probably be interesting.

FELIX RAWITSCHER.

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University of São Paulo.
March 13.

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[1] Firbas, F., *Naturwiss.*, **27**, H.6 (1939).

[2] Erdtman, G., *J. Ecol.*, **19**, No. 1 (1931).

[3] Salisbury, E. J., and Jane, F. W., *J. Ecol.*, **28**, 310 (1940).

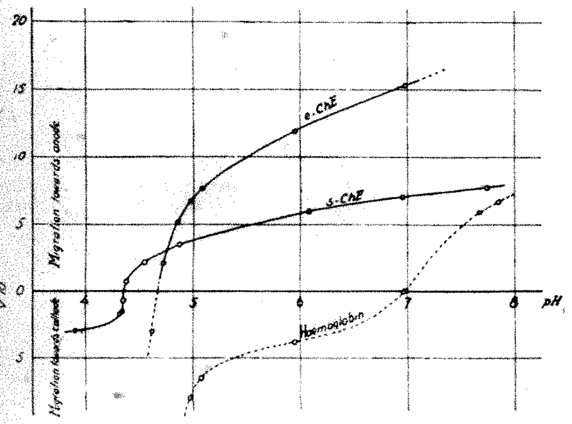
[4] Chavannes, E., *Sci. Monthly* (July 1941).

[5] Sears, P. B., *Amer. J. Bot.*, **29**, 684 (1942).

Choline Esterases

A DEFINITE proof that two distinct choline esterases really exist has been sought by Bader *et al.*[1], who call for an "electrophoretic or closer elementary analysis". I have reported such an analysis in a recent paper[2], which has obviously not reached these authors.

I have shown that a true chemically established difference exists between the acetylcholine-hydrolysing enzymes in horse blood serum and red blood cells. Cataphoretic investigations show that a large difference exists between the rates of migration of the two enzymes in the electric field. This is shown in the accompanying figure (for details, see the original paper). Furthermore, erythrocyte choline esterase seems considerably more sensitive to pH than serum choline esterase.



It may thus be definitely stated that the choline esterases from blood serum and erythrocytes are not identical.

The next question to be decided is whether choline esterase from blood cells is identical with the enzyme in brain. Work by Canadian and Swiss schools have shown that this is in fact the case. I am at present engaged in an attempt to prove this chemically. Preliminary examinations have shown the permanence towards pH-changes of the brain choline esterase (ox) is much the same as that of erythrocyte choline esterase. Thus the brain choline esterase is wholly destroyed at $p\mathrm{H} \approx 4 \cdot 7$ and has lost 40 per cent of its activity at $p\mathrm{H} \approx 6$. The corresponding figures for the erythrocyte choline esterase are $p\mathrm{H} \approx 4 \cdot 5$ and 50 per cent at $p\mathrm{H} \approx 5$, for serum choline esterase $p\mathrm{H} \approx 2$ and no loss of activity at $p\mathrm{H} \approx 6$.

In a letter addressed to Dr. Zeller in Basel in October 1943, I expressed the opinion that it is highly probable that we must henceforth take into consideration even more types of choline esterase. Many facts suggest this. Thus the enzyme in mollusc hepatopancreas and choline esterase in the venom of *Cobra* have not the same properties as either of the two types mentioned above. Indeed we know very little about the specificity of choline esterase in invertebrates. An investigation in this sphere is being planned.

I largely agree with Richter and Croft[3] in their statement that "it would appear more accurate to describe the choline esterases as a group of enzymes showing considerably divergent properties rather than to regard choline esterase as a single entity".

K.-B. AUGUSTINSSON.

Biochemical Institute of the University,
and Chemical Institute of the Veterinary College,
Stockholm.
May 25.

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[1] Bader, R., Schütz, F., and Stacey, M., *Nature*, **155**, 239 (1945).

[2] Augustinsson, K.-B., *Ark. Kem., Mineral. Geol.*, **18** A, No. 24 (1944).

[3] Richter, D., and Croft, P. G., *Biochem. J.*, **36**, 746 (1942).

A Theory of Telepathy

IN his recent review[1], Dr. E. J. Dingwall includes a quotation which refers to an alleged disintegration of memory in trance personalities.

This should not be considered without reference to the natural disintegration of memory throughout life. If any personality is observed through life from the time of his graduating or passing professional examinations, there is a gradual dispersal of the knowledge gained, in spite of the fact that his environment is such that the knowledge would be of considerable value. If we assume a continuation of this process after the death of the body, then, in view of the fact that the new environment no longer demands retention of earth-memories, it is surely remarkable that they persist as long as they do.

A. T. ORAM.

Belle Vue House,
Devizes.

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[1] *Nature*, **155**, 619 (1945).

Custody of Uranium

MANY of us have used specimens of pitchblende as demonstration pieces, perhaps to take autophotographs during the course of a lecture. The newly disclosed potential menace of a pound weight of such material brings with it a warning that those entrusted with the custody of any uranium-bearing minerals should take their obligations seriously; from careless hands uranium might pass to unscrupulous ones.

SIDNEY RUSS.

Barnato Joel Laboratories,
The Middlesex Hospital,
W.1.

RESEARCH ITEMS

Low-Temperature Limits of Life

The temperature of water inhabited by living organisms is assumed not to fall below $-3\cdot3°$ C. In the salt lakes of Kazakhstan, however, water becomes cooled well below that limit while still remaining liquid, and plankton investigations by S. A. Zernov and O. I. Schmalhausen (*C.R. Acad. Sci. URSS.*, **44**; 1944) have shown that motile algæ, *Pyramimonas* sp. and *Dunaliella* sp., are able to survive winter in salt water cooled down to $-5°$ C. and even $-7\cdot75°$ C., remaining fully active. Various other algæ of the genera *Oscillatoria*, *Nodularia*, *Glœotila* and *Botryococcus* also appear to be able to survive such temperatures. Under experimental conditions, both *Pyramimonas* and *Dunaliella* were found to survive and swim in a drop of salt water from the lake cooled down to $-15°$ C. The upper temperature limit for *Pyramimonas* was experimentally found to be $+29°$ C., and for *Dunaliella* $+42°$ C.

American Clingfishes

L. P. Schultz has subjected the American species of Gobiesocidæ to a thorough revision and described new genera and species (*Proc. U.S. Nat. Mus.*, **96**, No. 3187; 1944). The clingfishes are mostly marine, but a few species occur in freshwater streams, a short distance above brackish water, clinging to the stones. *Gobiesox cephalus* Lacepède is one of these and occurs in freshwater streams of northern South America and Central America on the Atlantic side, and there are four other American species. A key to the genera and species of the American Gobiesocidæ is given, including nine genera and twenty-four species, and a table of counts made on the dorsal fin rays, anal fin rays, pectoral fin rays above attachment of gill membrane, and pectoral fin rays.

Mutations in Bacterial Virus

S. E. Luria (*Genetics*, **30**, 84; 1945) shows that α and γ, the two viruses of *Escherichia coli*, produce by mutation new strains which are able to attack strains of the bacterial host which were resistant to the original virus strains. Mutation in bacteria and in these viruses in respect of resistance is specific and is generally independent; in one exceptional case a bacterial strain resistant to α and α^1 reverted to susceptibility as a result of a mutation to resistance to virus γ and γ^1. The changes in resistance are considered by the author not to be due to adaptation.

Biennial Bearing of Apple Trees

Biennial bearing, to which many apple varieties are prone, is one of the important causes of gluts. Attempts to modify this character and at the same time to provide a satisfactory thinning of the crop by the use of caustic sprays at blossom time have been made in the United States. The sprays used generally have a basis of sodium dinitrocresylate or other similar dinitro compound; but the difficulties in their use are numerous. F. S. Howlett (*Proc. Amer. Soc. Hort. Sci.*, **42**, 151; 1943) has described how the thinning effect differs with the variety and with the season, while A. B. Burrell (pp. 159–162) points out that even a single spray may result in an excessive thinning of the crop. Nevertheless the early fruit thinning (supplemented when necessary by hand thinning in June) is advantageous in that it reduces competition between fruits early in the season, and this may be one reason why sprayed trees give larger fruits than hand-thinned trees, as reported by A. V. Doren and M. B. Hoffman (pp. 182–184). A further effect of the reduction of crop in an 'on' (that is, bearing) year brought about by this treatment may be an increased initiation of fruit buds, so that blossom and fruit production in the following 'off' year (M. B. Hoffman and J. D. Van Geluwe, pp. 185–186) are both increased and the biennial-bearing habit thus somewhat, although not markedly, modified. This effect of the caustic spray may be intensified by branch ringing in the 'on' year (A. E. Murneek, pp. 163–166); but sometimes the complete removal of the crop by spraying the bloom with a caustic spray fails to induce flowering in the following 'off' year (A. E. Murneek, pp. 177–181).

Chalk-washing of Sugar-Beet in Dry Climates

Sugar-beet plants cultivated in hot, dry climates are liable to wilting. The problem has serious economic importance in some regions of the Soviet Union, such as the Northern Caucasus and Middle Asia, but ingenious experiments in chalk-washing the plants, with the view of reducing the absorption of radiant heat, carried out during 1932–41 (Kolossov, *C.R. Acad. Sci. URSS.*, **42**; 1944), have proved that this process reduces wilting. When leaves were covered with a 10 per cent suspension of chalk in water, their transpiration decreased by 14–23 per cent; the osmotic pressure of the sap fell from 17·8 to 14·2 atmospheres; the temperature of chalk-washed leaves was reduced by 4·5° C. The yields were increased by the treatment, in the case of roots by 13–14 per cent, and in the case of seed plants by 19·7 per cent. Germinating capacity of seeds from treated plants was not affected; but their energy of growth was considerably higher and the number of shoots per seed was greater than in the controls.

Structure of the Vredefort 'Dome'

The Vredefort 'dome', situated in the northern Orange Free State and the southern Transvaal, has long been a tectonic enigma to geologists. It has hitherto been described as a nearly circular mass of Older Granite 26 miles in diameter, surrounded by concentric belts of sedimentary rocks which are overtilted and inverted through a thickness of several thousands of feet, so that they everywhere dip inwards towards the granite. The south-easterly part of the structure, however, is hidden beneath a horizontal cover of Permo-Carboniferous strata. A highly significant correction to this reading of the structure is suggested by the results of a gravimetric survey carried out by B. D. Maree (*Trans. Geol. Soc. S. Africa*, **47**, 183; 1945). Large and easily recognizable gravitational anomalies were found to exist on the sedimentary belts, and when these were traced to the covered south-eastern portion, the structure, instead of being circular, was found to have the shape of a pear, with the tapering end pointing to the south-east. The anomalies are arranged symmetrically about an axis striking 32° west of north, through the middle of the exposed mass of granite. There is no longer any necessity to postulate vertical, centripetal and evenly distributed forces to account for a supposedly circular structure symmetrical about a point. The observed overtilting of the sediments in the north-west can now be ascribed to a tectonic deformation directed superficially from the south-east, the core of Older Granite being infolded with the sediments. This interpretation is consistent with the existence of a big thrust fault at Potchefstroom. The gabbro sheets and bosses of alkali rocks of the region represent post-tectonic phases of magmatic activity. The aureole of metamorphism and a marked area of positive anomalies found over the Older Granite indicate that the great bulk of these later igneous rocks is still concealed. The survey has disclosed the high probability that a large area is underlain by the Witwatersrand System with dips that would favour mining activities. It remains for the drill to prove the possible presence of gold-bearing banket in these formations.

Nuclear Energy Generation in the Sun

THE only source of energy generation in main-sequence stars which has as yet been found to satisfy even remotely the astrophysical requirements is the Bethe carbon cycle. In this process, a helium nucleus is formed from four protons, with the emission of energy in the form of γ-radiation, the process being catalytically assisted by a carbon nucleus. Attempts at determining the internal distribution of temperature and density in the sun, on the basis of a model in which all the energy is generated by this means in a convective core surrounded by a radiative envelope, have met only with qualitative success, however. Although the hydrogen content needed to fit such a model agrees with Eddington's value of 35 per cent, and the central temperature and density are not unreasonable, use of the carbon cycle to predict the luminosity gives a result nearly 150 times the observed value. This discrepancy, however small compared with those resulting when other nuclear reactions are assumed, has undoubtedly delayed general acceptance of the carbon cycle. Now, however (*Astrophys. J.*, **100**, 347 ; 1944), N. R. Sen and U. R. Burman have developed a solar model based on Bethe's law which is much more satisfactory. With a given composition and central temperature, a series of cores is studied, each corresponding to a particular central density. Only one of these satisfies Bethe's law and the boundary conditions ; in it the central temperature is the commonly accepted value of $20{\cdot}2 \times 10^{6}$ degrees, but the central density of $45{\cdot}5$ gm./cm.^{3} is very much smaller than the value ordinarily assumed. This model gives a total luminosity within 2 per cent of the observed energy output, a mass 7 per cent larger and a radius 1·5 per cent larger than the observational values. Still better agreement with observation is predicted if minor adjustments are made in the constants used.

Surge Characteristics in Electric Transmission

IN a paper (*J. Inst. Elec. Eng.*, **92**, Pt. 2, No. 25, Feb. 1945) on "Surge Characteristics of a Three-Phase Transmission Line with Earth Wire", W. G. Hawley deals first with the data and formulæ necessary for evaluating the self and mutual surge-impedance values of a three-conductor overhead system equipped with a single earth wire. It is then indicated how these impedances may be used for obtaining the theoretical attenuation and distortion, below corona, of standard unidirectional surges. Good agreement is shown to exist between theory and experiment. Above corona, loss factors for the short surges employed are deduced from experimental results, and formulæ are given to enable the corresponding factors for any single-circuit line conductor to be found. Formulæ for determining the visual critical corona voltages of one, two or all three conductors of a system are also given, in terms of the relevant surge impedance values. Finally, several values for a typical line are included.

Over-Current Relays on Medium-Voltage Circuits

A PAPER read by A. G. Shreeve and P. J. Shipton before the Institution of Electrical Engineers reviews existing methods of protection from excess load current in medium-voltage circuits, and outlines some of the problems encountered with the wide variation of industrial applications. British Standard Specifications dealing with excess current are considered, suggestions are made to correlate them, and the main factors which determine the protection required are reviewed. Motor starting-loads, starting times, and various duty cycles are mentioned, and reference is made to faults which can be caused by the inherent characteristics of some electrical equipment. Existing basic designs of overload relays and some of the difficulties experienced with them are dealt with, and an outline is given of the effect of temperature variation on thermal- and oil-type devices, and of excess current due to lost-phase faults, together with suggestions for the type of protection required to meet various circuit conditions. The relation of equipment to both excess load – current capacity and short-circuit rupturing capacity is considered, and attention is paid to the correlation of fuses and overload relay design with the thermal rating of electrical gear in the protected circuit.

Tensile Load on Steel-Cored Aluminium Conductors

A PAPER read by E. W. W. Double in London on April 11 before the Institution of Electrical Engineers dealt with the distribution of tensile load on steel-cored aluminium conductors in relation to their temperature and sag. The main objects of the investigation were : (1) to determine the effects of temperature and tension upon the sharing of the tensile load between the steel and aluminium components of such a conductor ; (2) to ascertain whether variations in the load distribution seriously affect the normal sag and safety of the conductor ; and (3) to propose measures for ensuring that the normal sag remains unaffected after the stringing of the conductor. Tensions in the steel and aluminium at various points along typical conductors were measured by a magnetic method. The effects of load-distribution changes were also estimated by noting the corresponding variation in the elastic modulus of the conductor. Adhesion between the steel and aluminium was also examined. The results indicated that the final load distribution is determined by the rate of creep in the aluminium wires, and is independent of the stringing temperature. Although more data concerning creep are required, the tests suggested that it will be some years before creep has any marked effect. It was found that the inelastic stretch of a conductor can cause large increases in sag which far outweigh those that might result from creep. Most of the inelastic stretch was removed when the conductor was tensioned up to the maximum design load, and stressing the conductors before final stringing is therefore strongly recommended. The steel core appears to carry slightly more than its share of the total load, but since its safety and that of the conductor are not threatened thereby, no change in the British Standards Specification governing the strength of steel-cored aluminium conductors is advocated.

ASPECTS OF THE DETERMINATION OF THE STRENGTH OF MATERIALS

A MEETING of the British Rheologists' Club was held on June 16 at the Royal Aircraft Establishment, Farnborough, Hants, in the Assembly Hall, through the courtesy of the director, Mr. W. S. Farren, the subject chosen being the "Strength of Materials". Dr. W. Douglas, head of the Materials Department of the Establishment, took the chair in the absence in the U.S.S.R. of the president, Prof. E. N. da C. Andrade. For those unfamiliar with the Establishment, it may be added that it is a directorate under the Controller of Research and Development of the Ministry of Aircraft Production. It is the chief research and experimental station under the Ministry, and it is concerned in all those fields of fundamental and applied science which influence the design, construction and performance of aircraft, military and civil, and in the equipment of aircraft.

Dr. M. C. Pryor, in a paper entitled "Wood and Glue", spoke during the morning session on the molecular and micro structure of timbers used in aircraft construction, and of the micro methods employed after an accident to establish the cause of mechanical failure. The movement of micelle aggregates during deformation is accompanied by rupture with the formation of fresh surfaces between the lignin and cellulose portions in the strained and damaged areas, and these fresh surfaces can be selectively stained. Failures by compression or tension are easily distinguishable microscopically, as originally shown by W. Robinson (*Phil. Trans.*, B, **210**, 49 ; 1920). Under compression, the tracheids in the zone of failure are considerably buckled. The zones of failure, which usually are well defined, run in planes at an angle of about 45° to the compression stress. Under tension, failure develops along slip planes in the substance of the cell walls, and these local shear failures occur in isolated points where the tube wall is weak, so that the failures are scattered up and down the members over quite a wide distance, perhaps for several inches. Some of the microphotographs shown at the meeting illustrating the general behaviour are reproduced herewith.

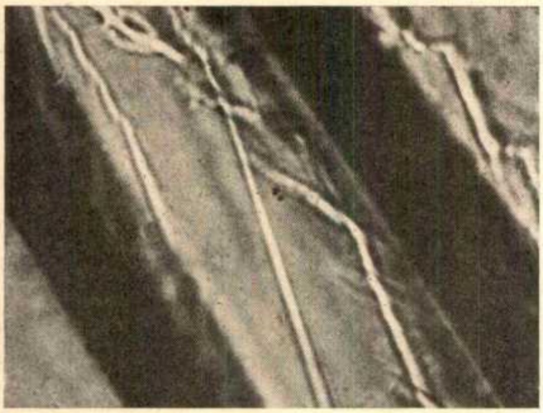


Fig. 1. TENSION FAILURE OF SITKA SPRUCE, FROM AN AIRCRAFT SPAR; LONGITUDINAL RADIAL SECTION, SHOWING PLANES OF FRACTURE. × 1,000.

Mr. C. Gurney read a paper on the "Effect of Duration of Loading on the Strength of Brittle Materials". Some brittle materials, particularly mineral glasses, are known to be subject to static fatigue, the breaking load decreasing with duration of loading; for example, experiments on an annealed soda-lime glass showed that the strength decreased in the ratio 3 : 1 when the duration of loading was increased from 10^{-2} to 10^{4} sec. It is generally accepted that the weakness of brittle materials is due to cracks, as suggested by Griffith. A likely explanation of the time dependence of strength might be the gradual spread of cracks; Griffith, after considering the energy conditions necessary for the spread of cracks, concluded that crack-spreading could not occur until a critical load was reached; at this load the crack spread catastrophically, and failure was immediate. In these circumstances, the only previous explanation of failure after prolonged loading which is consistent with general principles is damage to the surface material by atmospheric attack. If glass is rapidly broken, there may be no time for atmospheric attack of the growing surfaces of the crack, so that a relatively high strength corresponding to the uncontaminated surfaces is obtained. A number of processes by which cracks may spread, consistent with the laws of thermodynamics, were described, and a new estimate of the strength of flawless materials was given. Stress reduces the height of atomic energy barriers, and immediate failure of a uniformly stressed material will occur when the average thermal motion is just sufficient to overcome the average energy barrier. This condition is approximately that at which the latent heat of isothermal evaporation is zero.

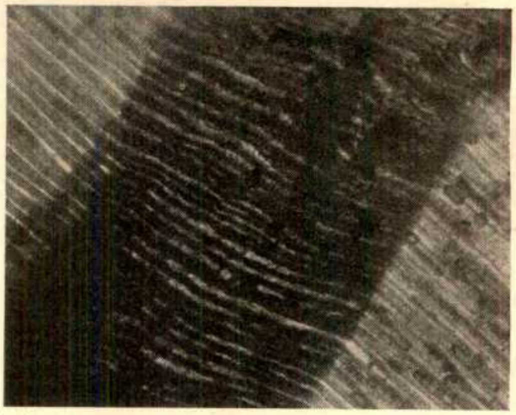


Fig. 2. ZONE OF FAILURE IN DOUGLAS FIR, STAINED WITH ZINC CHLOR IODIDE. × 60.

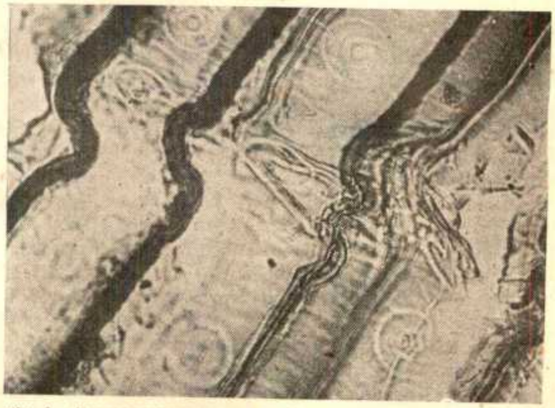


Fig. 3. COMPRESSION FAILURE IN DOUGLAS FIR, SHOWING EARLY STAGE OF BUCKLING OF TRACHEIDS. × 400.

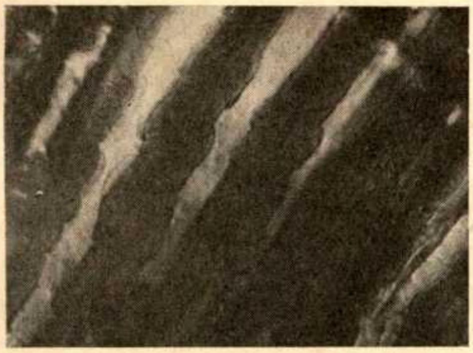


Fig. 4. Compression failure in Douglas fir, showing slip planes within the cell walls. × 650.

At lower stresses, failure is still possible, but it takes time. The stress-free vapour pressure of strong solids is extremely small, but it has been shown that the logarithm of the vapour pressure is approximately proportional to the square of the stress, so that the vapour pressure becomes appreciable at high stresses such as can occur at the end of cracks. The rate at which cracks spread by evaporation of the material has been estimated and found to be insufficient to account for the whole of the time effect with mineral glasses, tested under atmospheric conditions. In a material the atomic arrangement of which is in thermal equilibrium, increase in crack-length by splitting without atomic migrations can only occur at loads in excess of that given by the Griffith criterion. It has hitherto been thought that failure was immediate at the Griffith load, but it has been shown that, for materials having atomic constitution, the Griffith load is the lowest at which the crack may start to spread by splitting, the rate of spread being a function of the stress difference between that at the end of the crack and the maximum the material can withstand. For materials not in thermal equilibrium, the application of stress by reducing the height of energy barriers enables the approach to equilibrium to continue; and if this involves heterogeneous volume changes, internal stresses are set up which cause cracks to spread. Atmospheric attack, involving weakening of the surface material and possible solution of material at the ends of cracks—solubility increases very rapidly with stress—is likely to be an important factor in causing fracture under prolonged loading, when tests are made under ordinary atmospheric conditions.

In the discussion which followed, Dr. E. Orowan spoke on the mechanism of crack spreading and emphasized the importance of atmospheric attack. Dr. Maunder Foster mentioned the high stresses produced during grinding and their effect on reduction of molecular weight.

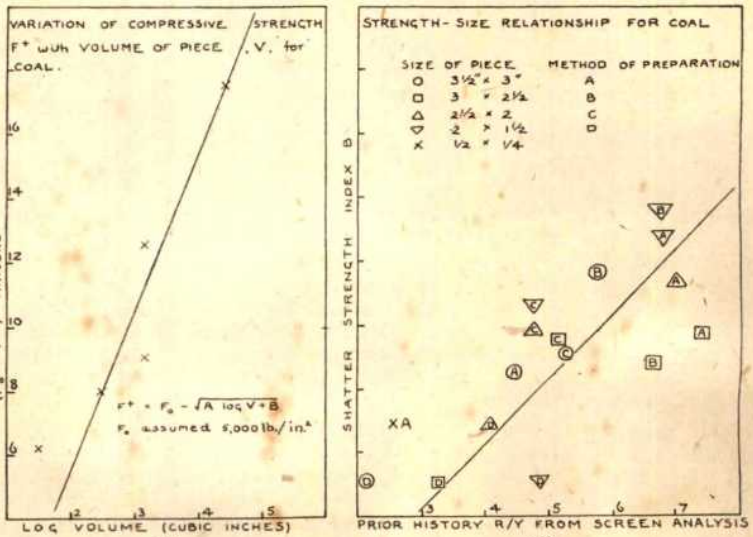
During the afternoon session, Dr. B. Chalmers, in a paper with Mr. E. R. W. Jones, on the "Application of Statistical Methods to Mechanical Test Results", gave a brief account of reasons for adopting a statistical approach to the interpretation of mechanical test results; and examples were given of significance testing, assessment of correlation and curve-fitting in relation to experimental results.

Strength tests are in general destructive, so that it is impossible to apply them to the component to be used. When they are non-destructive, the measurement is not of the property under consideration but of another property in some way related to it. In either case one requires a basis for inferring mechanical properties of the component from the known properties of the specimen tested. It was pointed out that the three reasons for doing mechanical tests are: (*a*) to provide design data; (*b*) to determine whether two or more batches of material are significantly the same in the mechanical property examined; and (*c*) to provide the basis for establishing the rheological laws for the material.

It was emphasized that, in all statements of the numerical value of a quantity, it is desirable to quote both the mean and an estimate of the scatter, based on the standard deviation.

The importance of using impersonal methods for fitting curves was demonstrated by an example in which significantly different results were obtained by various observers interpolating on the same experimental points. In conclusion, a method of presenting results of fatigue tests was shown giving the stresses below which only a stated percentage of specimens would be expected to fail. The view was expressed that this is the logical method of expressing such information in cases where the data are to be used quantitatively for design purposes.

In a written contribution, Mr. R. L. Brown, of the Coal Utilisation Research Association, continued the discussion by referring to the statistical approach and the application of the Griffith crack theory to the strength of coal. In compression tests on cubical cylinders where the load is increased slowly until failure occurs, the worst crack determines the strength. Applying Frenkel and Kontorova's work on the 'worst' crack theory to the effect of size of specimen, it is found that data for coal are well represented (Fig. 5*a*).



(*a*) (*b*)

For size x in., R = per cent greater than size (x) and Y = yield of size x, per cent per inch, in consignment from which samples for test are taken.

Fig. 5.

In shatter tests, strength can be assessed by the amount of breakage when a sample of a hundred or so pieces of coal is dropped 6 ft. on to an iron plate. Here the extent of cracks rather than the worst crack determines the strength. If it be assumed that the deformation caused by a sudden blow is elastic and that failure occurs when the strain energy exceeds a certain average value E (the value of E depends on the extent of pre-cracking and a hypothetical strain energy), then a formula can be derived for the shatter strength in terms of two factors ; first, the amount of breakage, and secondly the size distribution of the dust produced.

The size of the specimen now affects its strength in a rather different way. In Fig. 5*b* the linear relationship between shatter strength and the size distribution of the consignment from which the coal for test is taken (R = per cent oversize, Y = yield in per cent per inch) indicates that the shatter strength is proportional to the difference of the size subjected to test from the biggest material present (which is approximately R/Y) the departure being in the sense that the strength increases with decreasing size. This linear relation has been derived theoretically and will be published shortly.

The linear relationship shown in Fig. 5*b* is interesting in that it enables the strength of the coal to be predicted from its previous history, so far as this is shown by the size distribution of the consignment. In other words, the handling of coal results in invisible breakage (or cracks and loss of strength) and visible breakage, and these two forms of breakage are balanced as shown.

A CONSTITUTIONAL SYNTHESIS OF CHONDROSAMINE

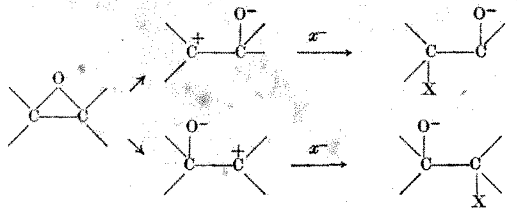
By Drs. SYBIL P. JAMES, F. SMITH, M. STACEY and L. F. WIGGINS

Chemistry Department, University of Birmingham

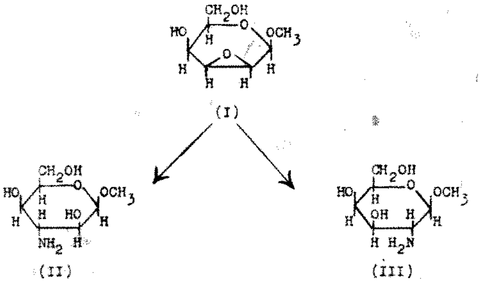
THE naturally occurring *d*-aminohexoses, glucosamine and chondrosamine, have long been known and are widely distributed in biologically important polysaccharides[1]. Any precise configuration of these substances, however, eluded chemists until 1939[2], when a derivative of glucosamine was synthesized by a method which proved conclusively that this amino-sugar was configurationally related to glucose, a conclusion confirmed independently by X-ray crystallographic methods[3]. The configuration of chondrosamine or its derivatives, however, has not been elucidated hitherto. It is generally believed that chondrosamine, the amino-sugar of cartilage[4], is related to *d*-galactose, with its amino-group on the second carbon atom[5], and it can certainly have only one of two configurations, namely, that of *d*-galactose or *d*-talose, since the amino-sugar can be transformed with loss of its amino-group into galactose phenylosazone[6,7].

The problem of deciding the configuration of chondrosamine has engaged our attention for some time, and by application of the technique of anhydro-ring formation and scission[2], we are now able to report a synthesis of chondrosamine by a procedure which determines its constitution.

The method is dependent upon the discovery[8] that anhydro-rings of the ethylene oxide type formed by the alkyl-oxygen fission of suitable esters (*p*-toluene sulphonates) undergo ring-scission in both the possible directions, that is, by rupture of the bonds on either side of the oxygen atom of the three-membered ring, and in each case Walden inversion occurs when an entering anion attaches itself to the carbonium cation in the manner shown below.

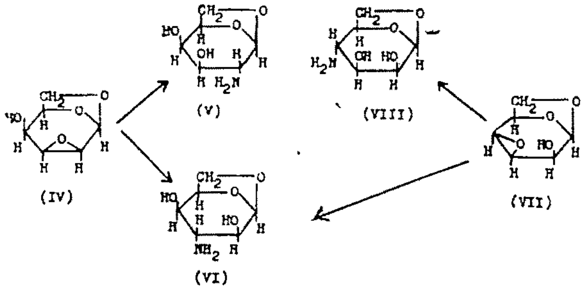


Thus the ring-opening of a derivative of 2 : 3-anhydro-allose with sodium methoxide gives rise to 2-methyl altrose and 3-methyl glucose, and if the ring opening is effected through the agency of ammonia, then the corresponding amino-sugars are obtained. Applying this reaction to a derivative of 2 : 3-anhydro mannose, Haworth, Lake and Peat[2] obtained a 3-amino-altrose (epiglucosamine) derivative and a 2-amino-glucose derivative, the latter being identical with that obtained from natural glucosamine. It was clear, therefore, that with a derivative of 2 : 3-anhydro-talose, ring fission with ammonia should lead to the formation of 3-amino-idose and 2-amino-galactose, which could then be compared with the corresponding derivatives of chondrosamine. Such a derivative of talose, 2 : 3-anhydro-β-methyltaloside (I), was made by one of us[9] and subjected to ring-fission with ammonia. One compound only, namely, 3-amino-β-methylidoside (II), could be isolated in crystalline form, presumably owing to the proportion of the second compound, 2-amino-β-methylgalactoside (III), being small.



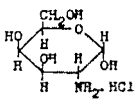
However, 1 : 6-2 : 3-dianhydro-β-talose (IV) (cf. ref. 10), a compound obtained by the alkaline hydrolysis of 2-mesyl-1 : 6-anhydro-β-galactose, appeared to provide more suitable initial material. Its two anhydro-rings have widely different stabilities, the ethylene oxide ring being easily broken by both acid and alkaline reagents, whereas the 1 : 6-anhydro-linkage shows considerable stability towards alkaline reagents but can be broken by acid reagents. Therefore, by treatment of this dianhydride with ammonia, we expected to obtain 1 : 6-anhydro-2-amino-β-galactose (V) and 1 : 6-anhydro-3-amino-β-idose (VI), and by analogy with the investigations on 2 : 3-anhydro-β-methyltaloside, (VI) would be expected to be predominant. There would then remain to be settled the question as to which of the compounds was the idose derivative. This problem could be approached from a consideration of the products obtained by scission of 1 : 6-3 : 4-dianhydro-β-talose[11]

(VII) with ammonia. Theoretically this treatment should give rise to 3-amino-1 : 6-anhydro-β-idose (VI) and 4-amino-1 : 6-anhydro-β-mannose (VIII). Thus the common substance isolated from the ammonolysis of both dianhydro compounds would be 3-amino-1 : 6-anhydro-β-idose. As a natural corollary the second product from the ring opening of 1 : 6-2 : 3-dianhydro β-talose would be the 1 : 6-anhydride of 2-amino-β-galactose (V), and the second product from the ring-scission of 1 : 6-3 : 4-dianhydro-β-talose would be 4-amino-1 : 6-anhydro-β-mannose (VIII).



The practical verification of these predictions has been clearly achieved in the following way: Treatment of 1 : 6-2 : 3-dianhydro-β-talose with ammonia under pressure gave, after subsequent treatment with hydrochloric acid, a crystalline hydrochloride (*A*) in 56 per cent yield together with a residue which, after acetylation, yielded a crystalline triacetyl amino-anhydrohexose (*B*). Similarly, 1 : 6-3 : 4-dianhydro-β-talose gave a crystalline hydrochloride (*C*) in 65 per cent yield, and a triacetyl amino-anhydrohexose which was identical with (*B*) above. The common product (*B*) must therefore be 3-acetamido-2 : 4-diacetyl-1 : 6-anhydro-β-idose, (*A*) must be 2-amino-1 : 6-anhydro-β-galactose hydrochloride and (*C*) must be 4-amino-1:6-anhydro-β-mannose hydrochloride. It is interesting to observe that, whereas in the ammonolysis of 2 : 3-anhydro-β-methyltaloside the idose derivative predominated, in that of 1 : 6-2 : 3-dianhydro-β-talose, the idose derivative was obtained in extremely small amount and was only isolated by virtue of its remarkable readiness to crystallize.

The 2-amino-1 : 6-anhydro-β-galactose hydrochloride was heated with strong hydrochloric acid, that is, under conditions in which the 1 : 6-anhydro-ring opens and no configurational change other than that on C_1 can occur.



(IX)

2-Amino-α-galactose hydrochloride (IX) was obtained in well crystalline form and showed an initial specific rotation of $[\alpha]_D + 125°$ changing to $+ 98°$ in one hour. These figures agree closely with those recorded for chondrosamine hydrochloride. A comparison of the X-ray powder photograph of the synthetic 2-amino-α-galactose hydrochloride and of chondrosamine hydrochloride[7] proved their complete identity. Furthermore, it was possible from (V) to synthesize 2-acetamido-tetra-acetyl-β-galactose, which was identical in all respects with β-penta-acetyl chondrosamine[7].

It is therefore clearly proved that chondrosamine is 2-amino-galactose. Moreover, this synthetic route provides a better means for the preparation of pure chondrosamine hydrochloride than the method of isolation from cartilage.

Full details will be published elsewhere.

[1] Stacey, *J. Soc. Chem. Ind.*, 62, 110 (1943).
[2] Haworth, Lake and Peat, *J. Chem. Soc.*, 271 (1939).
[3] Cox and Jeffrey, *Nature*, 143, 984 (1939).
[4] Bray, Gregory and Stacey, *Biochem. J.*, 38, 142 (1944).
[5] Levene, "Hexosamines and Mucoproteins" (London: Longmans, Green and Co., 1925).
[6] Levene and La Forge, *J. Biol. Chem.*, 18, 123 (1914).
[7] Stacey, *J. Chem. Soc.*, 272 (1944).
[8] Peat and Wiggins, *J. Chem. Soc.*, 1810 (1938).
[9] Wiggins, *J. Chem. Soc.*, 522 (1944).
[10] Hann and Hudson, *J. Amer. Chem. Soc.*, 64, 2435 (1942).
[11] Hann and Hudson, *J. Amer. Chem. Soc.*, 64, 925 (1942).

IRON AGE FINDS FROM ANGLESEY

NEWSPAPER publicity has already been given to some extremely interesting Iron Age finds recently unearthed in the parish of Llanfihangel-yn-Nhowyn, near the west coast of Anglesey, some five miles to the south-east of Holyhead. The discoveries were made as a result of peat dredging work. It had become necessary to excavate certain bogs in the parish, and one day the attention of the clerk of works was directed to a chain which had been caught up in the teeth of a harrow used for spreading the peat. The chain itself had "come in handy" for dragging bogged lorries on to firm ground! Very wisely it was decided to ask Sir Cyril Fox to visit the site, and as a result of further investigations a large number of very important relics were rescued. Unfortunately, of course, no stratigraphical details could be obtained as excavation by bulldozer or grab does not lend itself to this kind of study; but the amazing fact is that a great many well-preserved objects were recovered which have enabled Sir Cyril to come to certain important conclusions. These appear, together with a detailed study of the finds, in a beautifully illustrated publication by the National Museum of Wales entitled "A Find of the Early Iron Age from Llyn Cerrig Bach, Anglesey" (7*s*. 6*d*.).

The report opens with a more detailed account of the site and the facts leading to the discovery than has been given above. There is also a map. There follows a description of the finds themselves classified under various heads: weapons, horse furniture, objects of social and economic interest, etc., with, in each case, one of those excellent distribution maps of kindred finds which we have learned to expect from the author. Perhaps the most intriguing object is a crescentic plaque of bronze with repoussé ornament. In the centre is a triquetra based on trumpet scrolls with lobed stems and domed mouths, three of which end on one side in a tendril curled round a boss. The whole design is asymmetric. Why this object was so decorated and what it was used for cannot as yet be determined. There follows a general discussion when such problems as dates, cultural affinities, whether the objects are a settlement find or a votive offering hoard, etc., are considered.

The objects can be dated to a period between 150 B.C. and the middle of the first century A.D. Indeed, the upper limit can probably be said to be the destruction of the British culture of the district by the Romans. The finds themselves show clearly that they are not all of local origin, that Anglesey was not a creative centre of art or craftsmanship. This is best seen in a study of the ten bridle bits. It seems clear that Llyn Cerrig was a focal point whither came objects from lowland Britain and from Ireland. This fact reinforces the suggestion that we are dealing with votive offerings—Anglesey, of course, was at this epoch a religious centre—and it would be difficult to postulate there a great market. If the finds do represent a hoard of votive offerings, we may well have to consider that for once we are really concerned with Druid activities, for in Mona who but Druids would supervise such rites at this period ?

Sir Cyril Fox is to be congratulated on having produced a very masterly interim report on these exceptionally important Anglesey finds.

M. C. BURKITT.

FORTHCOMING EVENTS

Tuesday, September 11

QUEKETT MICROSCOPICAL CLUB (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 7 p.m.—Conversation and the Exhibition of Specimens.

Wednesday, September 12

INSTITUTE OF METALS (at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1), at 10 a.m and 2.15 p.m.—Thirty-seventh Annual Autumn Meeting

Friday, September 14

INSTITUTE OF PHYSICS (ELECTRONICS GROUP) (at the Royal Society, Burlington House, Piccadilly, London, W 1), at 5.15 p.m.—Annual General Meeting. Dr. D. S. Evans . "Electronic Conditions in the Sun and Stars".

Saturday, September 15

CONFERENCE ON "FRIEDEL-CRAFTS CATALYSTS AND POLYMERISATION" (in the large Chemistry Theatre, The University, Manchester), at 10.30 a m. and 2 p.m.

Saturday, September 15—Sunday, September 16

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (at Portland Hall, Little Titchfield Street, London, W.C.1).—1945 ASLIB Conference.

Saturday, September 15

At 11.45 a.m.—Prof. J. D. Bernal, F.R.S. : "Information Service as an Essential Factor in the Progress of Science" ; at 2.30 p.m.—Symposium on "Links with the U.S.A.".

Sunday, September 16

At 3.30 p.m.—Discussion on "The Great Book Shortage—its Effect on Education, Research, Empire Intercommunication and the Reestablishment of Cultural Relations in Europe".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned :

ASSISTANT TECHNOLOGIST ENGINEER (with University Degree) for investigation of manufacturing and laboratory processes in connexion with Machinery and Plant Design, London area—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting C.2694.XA (September 14).

RESEARCH ENGINEERS (with University Degree and good workshop training) for development of Industrial Process Plant, London area—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting C.2408.XA (September 14).

AGRICULTURAL CHEMIST—The Acting Director of Agriculture, School of Agriculture, Houghall, Durham (September 15).

LECTURER IN AGRICULTURAL BOTANY—The Principal, Midland Agricultural College, Sutton Bonington, Loughborough (September 15).

LABORATORY ASSISTANT in the Division of Histology—The Bursar, Royal Veterinary College, Camden Town, London, N.W.1 (September 15).

LECTURER (full-time) IN THE DEPARTMENT OF CHEMISTRY—The Principal, Derby Technical College, Normanton Road, Derby (September 20).

CHAIR OF PHILOSOPHY, and the CHAIR OF HISTORY, at the University of Otago, Dunedin—The High Commissioner for New Zealand, 415 Strand, London, W.C.2 (September 21).

ELECTRICAL AND MECHANICAL ENGINEERS (temporary staff) for the Public Works Department of the Nigerian Government, (*a*) Electrical and Mechanical Engineer in charge of Construction, and (*b*) Electrical and Mechanical Engineers—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting D.1420.A (September 21).

MANAGERIAL TECHNICAL EXECUTIVE to a leading firm of manufacturers of Electrical Rotating Machinery in South-east England—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting C.U. 26.XA (September 21).

TOPOGRAPHIC SURVEYOR by Iraq Petroleum Co., Ltd., in the Middle East—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting E.1878.XA (September 21).

LECTURER IN CERAMICS (applicants should be Graduates in Science or Engineering with some knowledge of Chemistry)—The Principal, North Staffordshire Technical College, Stoke-on-Trent (September 22).

TECHNICAL ASSISTANT IN AGRICULTURAL ECONOMICS—The Acting Registrar, The University, Leeds (September 24).

FIRST ASSISTANT PORT ENGINEER by the Government of Iraq for the Basrah Port Directorate—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting E.1895.A (September 26).

LECTURER IN NEURO-SURGERY, and a LECTURER IN NEUROLOGY—The Registrar, The University, Manchester (September 28).

SUB-LIBRARIAN (KEEPER OF PRINTED BOOKS)—The Librarian, The University, Oxford (September 29).

CERAMICS SCIENTIST on scientific staff of Pottery and Ceramics Research Association in New Zealand—The High Commissioner for New Zealand, 415 Strand, London, W.C.2 (September 30).

ASSISTANT IN BOTANY—The Secretary, The University, Aberdeen (October 1).

ASSISTANT LECTURERS (2, Grade III) IN APPLIED MATHEMATICS—The Registrar, The University, Liverpool (October 1).

CHAIR OF CHEMICAL ENGINEERING tenable at the Imperial College of Science and Technology—The Academic Registrar, University of London, Richmond College, Richmond, Surrey (October 8).

SENIOR LECTURER IN CHEMISTRY at the Natal University College, Durban—The Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1 (October 15)

LECTURER IN CHEMISTRY (with qualifications in Inorganic and Physical Chemistry) at the Natal University College, Pietermaritzburg—The Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1 (October 15).

GENERAL MANAGER of the Croydon Gas Company—The Chairman, Croydon Gas Co., Katharine Street, Croydon (October 15)

ASSISTANT LECTURER IN GEOLOGY—The Registrar, The University, Sheffield (October 31).

ASSISTANT TO THE COUNTY LIGHTING ENGINEER—The County Clerk, Lanarkshire House, 191 Ingram Street, Glasgow, C.1 (November 3).

LECTURER IN VETERINARY SCIENCE, and an ASSISTANT LECTURER IN DAIRY TECHNOLOGY, at Massey Agricultural College (University of New Zealand), Palmerston North, New Zealand—The High Commissioner for New Zealand, 415 Strand, London, W.C.2.

TECHNICIAN (Grade B) IN THE PHYSIOLOGY DEPARTMENT—The Vice-Dean, St. Bartholomew's Hospital Medical College, at Queen's College, Cambridge.

TECHNICAL INDEXER (woman) on the staff of the Plant and Animal Products Department—The Establishment Officer, Imperial Institute, South Kensington, London, S.W.7.

ASSISTANT LECTURER IN CHEMISTRY (must possess an Honours Degree in Chemistry), an ASSISTANT TO THE ADVISORY CHEMIST (must possess experience of analytical work), and an ASSISTANT LECTURER IN DAIRYING (must possess a Degree in Dairying)—The Principal, Midland Agricultural College, Sutton Bonington, Loughborough.

PSYCHOLOGIST (part-time) at the Child Guidance Clinic—The School Medical Officer, Public Health Department, Stour Street, Canterbury.

PSYCHIATRIST (temporary, whole-time) or PSYCHIATRIST or PSYCHIATRISTS (temporary, part-time) in connexion with the Joint Child Guidance Service—The County Medical Officer of Health, County Hall, Lewes, Sussex.

LABORATORY TECHNICIAN (male, Grade B), and a LABORATORY JUNIOR TECHNICIAN (male, Grade C)—The Secretary-Superintendent, Royal Surrey County Hospital, Guildford.

TECHNICAL ASSISTANT TO THE ADVISORY BACTERIOLOGIST, South-Eastern Province, in connexion with the National Milk Testing and Advisory Scheme—The Advisory Dairy Bacteriologist, 39–41 Sackville Road, Hove 3, Sussex

REPORTS and other PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Scientific Proceedings of the Royal Dublin Society. Vol. 24 (N.S.), No. 4 : The Angular Distribution of Submarine Daylight in Deep Water. By H. H. Poole. Pp. 29–42. (Dublin : Hodges, Figgis and Co., Ltd. ; London : Williams and Norgate, Ltd., 1945.) 1*s*. 6*d*. [28

National Institute of Agricultural Engineering. Publication 505/45 : Research on Pneumatic Tyres for Farm Tractors. Report of Work carried out in 1939–40 by the Institute for Research in Agricultural Engineering, University of Oxford, for the British Rubber Producers' Research Association. Pp. 32. (York : National Institute of Agricultural Engineering, 1945.) 2*s*. [38

Society for Freedom in Science. Occasional Pamphlet No. 2 : Rights and Duties of Science. By Prof. Michael Polanyi. Pp. 18. (Oxford : Society for Freedom in Science, 1945.) 1*s*. 9*d*. [98

NATURE

No. 3959 SATURDAY, SEPTEMBER 15, 1945 Vol. 156

CONTENTS

Page

University Developments 311
Psychology of War. By Dr. William Brown . . 314
Human Embryology. By Dr. D. V. Davies . . 315
François Magendie (1783–1855). By Prof. E. D. Adrian, O.M., F.R.S. 316
Hay-fever Plants. By Dr. H. Godwin, F.R.S. . . 316
Methods in Climatology 317
Radar in War and in Peace. By Sir Robert Watson-Watt, C.B., F.R.S. 319

Science in the U.S.S.R.

Astronomy and Terrestrial Magnetism. By Sir Harold Spencer Jones, F.R.S. 324
Theoretical Physics. By Prof. M. Born, F.R.S. . 325

Obituaries :

Colonel C. H. D. Ryder, C.B., C.I.E. By Brig. Sir Clinton Lewis, O.B.E. 326
Dr. Catherine Alice Raisin. By Dr. Doris L. Reynolds 327
Prof. H. E. Annett, M.B.E. By Dr. Sarah Barnes 328
Dr. W. Knoche. By Dr. Otto Schneider. . 328
Prof. F. von Wettstein. By Dr. F. W. Sansome . 328
News and Views 329

Letters to the Editors :

X-Ray Analysis with the Aid of the 'Fly's Eye'.—Sir Lawrence Bragg, O.B.E., F.R.S., and A. R. Stokes 332
Striated Structure of Age-hardened Alloys.—Dr. M. L. V. Gayler 333
Fluorescence of Dipropyl Ketone at Low Temperatures.—Dr. S. C. Sirkar and B. M. Bishui 333
Hydrogen Bond Linking of Quinol Molecules.—D. E. Palin and H. M. Powell 334
Degree of Association of Water from the Energy of Viscosity and the Work of Cohesion.—L. Grunberg and Dr. A. H. Nissan . . . 335
The Fitzgerald Contraction as the Origin of our Experience of Time and its Lapse Rate.—Prof. W. Peddie 336
Bread in Jersey during German Occupation.—Dr. D. W. Kent-Jones and Dr. A. J. Amos. . 336
Progressive Clines.—F. W. Braestrup . . . 337
South African Onychophora.—Dr. S. M. Manton . 338
Use of Stereographic Projection for Statistical Problems.—Prof. Cyril Burt 338
Relation of the Gonadal Hormones to Certain Dermatoses. By Dr. Georges Garnier 339
Practice of Medicine in the United States . . 341
Oceanographical Results of the Last Voyage of the U.S. Non-magnetic Ship *Carnegie*. By Dr. G. E. R. Deacon, F.R.S. 341
Thatch Grass. By Dr. B. C. Sharman . . . 342
The Imperial Cancer Research Fund. 343

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UNIVERSITY DEVELOPMENTS

THE second report on "University Developments" issued by the Association of University Teachers, adopted by the Council of the Association last December, and which appeared in the *Universities Review* of May, has now been issued as a separate document. The report covers as wide a field as the first report, and deals with some questions which have been only briefly discussed in other reports on the expansion of the universities. Three broad subjects are covered : the place of research in the life of a university ; the relations of academic and industrial science ; and the university as a regional focus. The former includes a section on research in the faculty of arts ; but this would appear to be a fragment only of the document quoted and discussed so wisely by Bruce Truscot in "Redbrick and these Vital Days". The section on research in the faculty of science is even briefer, and beyond stressing the need for attention to such points as the improvement of the position of laboratory assistants, as well as in their number, and the place of group- or team-work in research at the universities, contributes little that is new. Criticism of research in the social studies is more searching and constructive ; and in urging that more and more adequate research in the social sciences is of the utmost importance because the progress of man in securing control over his material surroundings has not so far been accompanied by corresponding progress in controlling social and political organization and relationships, and in adapting human beings to their changing circumstances, the report suggests that much research on contemporary social conditions would be done better if initiated and directed by university departments. One reason for this is that it is difficult for an isolated group of persons to obtain access to, or command over, all the distinct disciplines and techniques required in the investigation, analysis and interpretation of complicated and many-sided social phenomena.

Social studies are very unevenly developed in the universities of Britain, and often there is little co-ordination between them. It is desirable that they should be further developed and brought into closer touch within each university and among universities. In her recent book on the training of the social servant, Elizabeth MacAdam referred to the place of the university in training such workers ; she pointed out that investigations into contemporary social conditions which arise out of such courses tend to stress social pathology. More studies of normal societies are needed ; for example, more knowledge of groups within society and of the relation of such groups to one another and to the whole ; of the problems of crowd and group psychology and of leadership ; of the relations of the sexes and the structure of the family ; of the social aspects of education ; and of the trends of change in all these. Moreover, since most social problems involve both facts and values, close relations must be developed between the social sciences and philosophy, and for some problems workers with a philosophical training ;

as well as a knowledge and understanding of social facts will be required. This section of the report accordingly pleads for further encouragement of more thorough research and more co-operation in research, based on historical data, comparative studies of contemporary societies, correlation of different specialisms, and greater co-ordination in planning inquiries. As an example, attention is directed to the economic and psychological as well as biological issues involved in social medicine.

In these separate sections, as in the more general sections on research, the vital importance of research in the life of the university is adequately emphasized and also its intimate relation with the teaching aspect. The two aspects are inseparable and cannot be divorced, and if, as Mr. Truscot points out, caution is necessary in accepting some interpretations of the word 'research' in the arts field, there can be no dissatisfaction with the emphatic defence of the right of full freedom of investigation to be found in this report. Moreover, it is highly satisfactory to find that the Association of University Teachers has not missed the importance to research of such matters as adequate library facilities, the finance of publications, or the interchange of staff which are emphasized so strongly in the report of Dr. Bowman's Committee on Science and the Public Welfare recently published in the United States. An all-round development of library facilities, including books, periodicals, buildings and staff is overdue. Scientific and learned books and periodicals appearing in foreign countries are often poorly represented on university library shelves. The weakness of the scheme for inter-library loans receives pointed comment, and the importance of some portion of the research fund being available to meet the expenses of publication and of greater facilities for exchange of staff between universities and other research institutions is well stressed.

The section of the report on the university as a regional focus deals with large questions which have been ably discussed by Bruce Truscot in both his books as well as in an article in *The Political Quarterly*, and they are also the subject of a lecture by Prof. B. Dobrée delivered at King's College, Newcastle-on-Tyne last year. Here it need only be said that universities will, as the report notes, function as centres of information and ideas for their regions, partly by the independent activities of individual members of university staffs, and partly through the extra-mural departments, the building up of which on a sound and firm basis with adequate recognition from the governing bodies is recommended as a first step. To this end the report suggests the appointment as directors of such departments of persons of academic distinction, with adequate administrative staff; provision of working apparatus and sufficient staff with their own board of study. Scarcely less important is the need for premises, and it is significant that the plan for the development of Manchester at present on exhibition makes liberal provision for exactly the type of accommodation suggested.

Leaving for the present the further comments of the report as to the principal forms of activity and development of the university as a regional focus, we may note that such activities provide a further reason for closer co-operation with other bodies and for some attempt to formulate a national policy for Britain, particularly in view of the post-war developments imminent in adult education. One form of these activities at least is closely related to that major question of the relation of academic and industrial science considered in the second section of this report. The importance of general refresher courses, of short specialist and advanced courses and *ad hoc* conferences among scientific workers and other professional men is now widely recognized. The Association of University Teachers suggests that the provision of such courses may be one of the most important developments of post-war adult education. The universities are the institutions obviously qualified to help in giving the required instruction, and it will demand from them a new approach and much hard work and clear thinking if the best use is to be made of a great opportunity to make an outstanding contribution to the intellectual life of the community. These courses, suggests the report, should be conducted in such a way as to bring about contacts between the various professions and the general public, so that there may be a wider understanding in the community of the basic work of the different professions. They should also help to re-establish touch between the universities and many of their alumni; and their financing, which will not be easy, should be done in co-operation with the professional bodies concerned.

It is to such co-operation between the universities and the professional bodies that we must also look, as the Nuffield College statement on problems of scientific and industrial research suggested last year, for the solution of some of the more difficult problems arising in the relations of academic and industrial science. That the Association's report should be concerned with these problems is the more welcome in view of the attention they have received in the United States by the able committee under Dr. Josiah Bowman as chairman, to which Dr. Vannebar Bush referred the consideration of questions relating to science and public welfare in preparing his report on a programme for post-war scientific research. The parallel in thought between the two reports is striking, and no one could wish for a more emphatic endorsement of the importance of the fundamental freedom of inquiry.

The universities, points out the Association of University Teachers, are the main sources of that fundamental research which, through subsequent development in the field of applied science, is one of the chief determinants of progress in a modern community; they are also the most effective institutions for ensuring that applied science is kept in full touch with expanding scientific knowledge. The Association claims that the highest standards of mental development and training in clear and critical thinking to which the university aspires to lead its students can be achieved through the teaching of technological subjects, as well as of the humanities or pure science, and urges that the development of the existing applied science departments is to be encouraged and new sections should be formed when sub-divisions have sufficiently increased in content and significance. In particular, the newer practical developments of biology should find full support in the expansion of teaching and of research; and special reference is made to the importance of genetics, ecology, and soil science.

Such developments represent one direction in which some measure of joint planning between the universities is desirable; and, again, in the establishment of new institutes for the application of fundamental research to the needs of industry, full consideration should be given to the arguments in favour of placing them near a university in the region most engaged in the industry concerned. Such institutions should maintain the closest touch with neighbouring laboratories engaged in fundamental research, and proper attention to this point should do much to close the gap between fundamental and applied science. The Joint Standing Council set up in Manchester last year by the University and the Chamber of Commerce is an example of the way in which such co-operation can be fostered.

The universities, however, must be the sole arbiters of the type of work which they shall undertake. There must be no suggestion that they should be in any way under the direction of the research institutes in this respect; and this freedom of fundamental research in the universities from external control is again stressed in connexion with the departments of applied science. In particular, the Association urges that the growing tendency of industries and individual firms to subsidize *ad hoc* research in universities on their own particular problems is in general to be resisted, as liable to lead to a form of commercial domination which is alien to the true university spirit and to the advancement of science itself. Effective contact with the industrial world can be maintained in other ways, and it is very desirable that assistance from non-industrial sources should be sufficient to ensure the independence of university research, especially on the technological side. In so far as applied research is carried out in university laboratories, the results should be immediately available to industry as a whole.

It is of course true that industrial research often discloses gaps in our more fundamental knowledge, and in this way industry may be able to indicate to the academic scientific worker problems which are worth investigation. Contacts between industry and the university such as are fostered by joint research councils of the type established at Manchester should encourage this cross-fertilization of ideas; and for this reason again the somewhat different problem of the engagement of professors or lecturers as consultants to firms or research associations requires careful handling. In principle, the intellectual resources of a university should be available to all in the community, and no restriction should be placed on the giving of advice by members of the academic staff, apart from the normal clause forbidding the acceptance of outside appointments without the consent of the university. So far as payment is concerned, the Association of University Teachers looks to the evolution of a code of professional conduct in such matters, as was suggested in the Nuffield College statement.

It will be seen, therefore, that the Association has covered the ground very thoroughly. Such questions as the relations between the universities and the technical colleges are also tentatively considered, and the importance of developing further links between them is recognized—for example, in addition to closer regional association, the setting up of joint standing committees by subjects, as well as between governing bodies, to investigate possibilities of mutual aid in the difficult post-war period is suggested. But what is most significant, however, is the extent to which the views urged by the Association find expression in the reports which have since appeared from Dr. Bowman's committee in the United States, already mentioned, and from the Commission on Higher Education in the Colonies. It would, in fact, be difficult to find a better brief exposition of the place of research in the life of the university than is contained in Chapter 6 of the latter report, and of the implications which arose from the acceptance of this conception of the place which the search for knowledge should hold in a university.

A university is not a continuation school in which the staff have time for research; it is an organ of higher learning inspired throughout by devotion to knowledge, and for the teaching staff the obligation to further knowledge in their special fields includes the duties of keeping constantly in touch with the results of research and of preserving a continual readiness to consider new ideas and to make the adjustments of outlook that follow from the acceptance of new data. For those who control universities, it means that the knowledge sought is desired for its own intrinsic value; the motive proper to a research worker is to extend the boundaries of charted knowledge in his own field wherever extension is intellectually most satisfying. Accordingly, utilitarian results must not be demanded from the research activities of members of the staff of a university, and their work must not be judged by its immediate bearing upon practical problems.

If these first principles are fully apprehended, and if those in control realize that in the long run universities will be judged by the contributions which they make to fundamental knowledge, there is little need to fear that some of the dangers to which Bruce Truscot and the Association of University Teachers direct attention will not be averted. It is not only in the Colonial universities that the choice of subjects for research is constrained by circumstances which make some desirable projects difficult or impossible to attempt, or that in the post-war world the necessary adjustment to new problems and new conditions may in itself provide a welcome and valuable stimulus. Again, in regard to the applied sciences, it is not the function of the universities directly to provide for the urgent application of science to improve health, agriculture or industry in the Colonies; to require the universities to do so would indicate a fundamental misapprehension of the place of research in universities. It is, on the other hand, an important duty of the university to train students to become applied scientists, and the abundance and attractiveness of local material, in the Colonies, as elsewhere, will not infrequently lead the university research worker, though untrammelled by the need to produce utilitarian results, to devote himself to inquiries which will have considerable practical significance. Equally, fidelity to such principles will be the surest guide in resolving the problems of relations and location between the institutes of applied science and the universities in the colonies as in Great Britain.

The Bowman Committee, in laying down similar general principles for the endowment of research in universities in the United States, has been influenced by the growing reliance of science departments of American universities upon industrial corporations for assistance. This, and the accompanying tendency to specify the projects for which grants to universities or to research institutions are to be used, have already been the subject of pointed comment. The Bowman Committee emphasizes the need for freedom in science, and refers to the need for guarding against the control of science by industry as well as against control of science by government. It points out, further, that reliance on industry in this manner may imply the distortion of university research in the direction of short-range problems at the expense of more fundamental research, as well as some decrease in the freedom of the university man of science.

The insistence in the Bowman Report on the necessity of devising ways and means of allocating funds in large measure without determining what particular problems are to be worked on and who is to execute them, and the importance of variety and decentralization of control in scientific work, where the fostering of novelty must be the first concern, is one way in which thought in the United States is clearly moving on similar lines to that in Great Britain. That in itself should help to overcome the complacency of which Bruce Truscot complains ; and it may well be that the increased contacts in certain fields during the War will have facilitated the further pooling of experience in dealing with some of these problems, and especially with the removal of those war-time obstacles which have hindered the free exchange both of information and ideas and scientific workers. The general desire of scientific men in Britain, the United States and the U.S.S.R. for more such contacts and for full freedom of communication is unmistakable ; but in the meantime this further report on university developments from the Association of University Teachers merits close study by all research workers. It is well to note that the Association, in consultation with the University members of Parliament, has drawn up a memorandum in which the more important needs of the universities are set forth in order of priority ; that memorandum, published in the *Universities Review* last May, also deserves attention by all concerned with education or research. The release of university staff and of students in Britain to complete their studies has received nothing like the priority that its importance for the new educational programme, the expansion of our research effort or industrial development demands.

PSYCHOLOGY OF WAR

Foundations of Human Conflicts

A Study in Group Psychology. By Dr. William A. Brend. Pp. viii+212. (London: Chapman and Hall, Ltd., 1944.) 15*s*. net.

THE psychology of conflict in human affairs, rising to an extreme of violence and cruelty in war between nations, is a subject of study second to no other at the present time. Although the great majority of educated and thinking people imagine that they can solve this problem in general terms by the light of common-sense and on the basis of ordinary experience, the mutually conflicting theories which they put forward indicate that no adequate solution can be reached in this way.

Dr. Brend's book may be regarded as the latest illustration of such a position. Although written by a sound physician with a legally trained mind and with a good working knowledge of medical psychology, it approaches the problem of human conflict along the lines of descriptive psychology, in which it is conscientiously precise and accurate, without probing more deeply into the fundamental springs of human activity.

Dr. Brend draws an important distinction between 'direct' and 'derived' emotions, and endeavours to explain the development of strife between groups, whether national or religious, between classes or ages, in terms of an artificial stimulation of derived emotions among the masses by the use of myths and symbols, by falsified history and irrelevant or outworn tradition, applied along the lines of the most up-to-date propaganda. He denies the existence of any instinct of pugnacity, or of the herd, or of religion, but considers that all these reactions are acquired by the individual after birth, under the influence of derived emotions which are, to say the least, inadequately controlled by reason and direct experience.

His ultimate solution would seem to be an extreme application of *rationalism* to the problem, whereby differences of nationality, of religion and of classes should be ultimately abolished. Nevertheless he shows little realization of the close and intimate relationship of the emotional and rational elements in the human soul, nor of the great importance of the 'spirited element' (τὸ θυμοειδὲς μέρος) as Plato saw it.

In spite of Dr. Brend's denial, there can be little doubt of the instinctive basis of pugnacity, gregariousness and the *general* religious attitude and outlook in man. There is an inborn tendency at the root of each of these mental reactions which is intimately related to a general instinct of self-preservation (*Selbsterhaltungstrieb*), even if we refrain from positing a more active tendency to aggression and to worship independently of individual experience. *Sublimation*, after release of repressions, is the only healthy result to be aimed at, and the only satisfactory solution of the problem of innate pugnacity.

Man is a fighting animal, and will at least defend himself when he is attacked. He will refuse to take unfavourable economic conditions lying down, and will combine and fight, both for his class and for his nation, when conditions become intolerable. In other words, he will fight to defend himself against objective enemies and difficulties.

But in his own individual development, onwards from infancy, he has had to contend with difficulties that were often too much for him, so that he has accumulated grievances and grudges, and, in general, *hates*, which continue to plague him from within, and their cumulative subconscious effect is to make him envious, spiteful and jealous, and unduly *suspicious* of his fellows, or some of them. He becomes on the defensive subjectively, and projects his stored-up hate and aggressiveness upon the people around him, considering them his enemies and putting himself on guard against them. In other words, he becomes *paranoid* in his mental attitude towards his environment.

As a member of a group, especially of a nation, with its sensitive national pride, his paranoid tendency is shared by his companions in relation to the common foe, and in their company he is ready to play his part in fighting the hostile nation by whatever means are available, sustained in his pugnacity by propaganda and by a consciousness of the rightness of his cause.

Once battle is joined, as in a dog-fight, he will not desist until he has destroyed the enemy or the enemy has destroyed him. The time to stop a war is before it starts. If nations were fully informed by their leaders of the facts of the international situation an outbreak of war might be delayed, but it would not necessarily be prevented. Nations and their leaders may be self-deceived at a deeper psychological level, and it is here that the psychological roots of war are to be found—in addition to the more obvious economic causes.

In other words, only by deep mental analysis—along the lines of Freud's method of psycho-analysis, but without prejudice as to the special sexual theory which he and his followers have developed in their study of both normal and psychopathological cases—can the full psychological meaning and causation of human conflicts, both individual and group, be revealed. Many investigators are now at work along these lines, and they have incomparable material in the latest war with Germany, if they know German and are prepared to make a *direct* study of the minds of Germans as well as those of their own countrymen, not omitting *themselves*. The end is self-knowledge, free from illusion or self-righteousness.

WILLIAM BROWN.

HUMAN EMBRYOLOGY

Human Embryology

(Prenatal Development of Form and Function). By Prof. W. J. Hamilton, Prof. J. D. Boyd and Prof. H. W. Mossman. Pp. viii+366. (Cambridge: W. Heffer and Sons, Ltd., 1945.) 31*s*. 6*d*. net.

ADVANCES in the field of human embryology during the present century have been dependent chiefly upon the acquisition of more abundant human material, particularly in the earlier stages of development, and upon its accurate observation and interpretation in the light of comparative and, to a lesser degree, experimental embryology. Undoubtedly the most notable recent advances have been in the study of early human and primate material, which is now becoming available in steadily increasing quantities. In this new text-book, the authors have attempted "a presentation of the subject of human embryology in the light of the advances which have been made in it during the past twenty years". They have, in general, succeeded in working into existing knowledge many facts which have been collected during the past twenty years.

The text follows the customary order, dealing in turn with the germ cells, accessory sexual organs, fertilization, implantation, early developmental stages, including the fœtal membranes and organogeny. Chapters are also included on some elementary and fundamental concepts of experimental embryology and on comparative embryology. Each chapter is provided with a list of references which are described as 'full'. It is regrettable that no mention has been made of the life-work of three great English anatomists, namely, Elliot Smith on the nervous system, Fawcett on the skull and Wood Jones on the urogenital system. There are detailed references to that great American publication "Contributions to Embryology", and its influence is much in evidence throughout the book both in the text and figures.

The illustrations are numerous, many being in colour. Original figures are in a minority, and do not attain the high standard of accuracy found in most of the copied or modified figures. It is a pity that there are inaccuracies in these figures, as in a text-book for students accuracy should come before all else. To mention some, in Fig. 136 the vertebral artery is labelled as a precostal anastomosis; Fig. 150 is that of a sagittal section of a fœtal head and conveys an entirely false impression as to the form and dimensions of the nasal cavity at this stage. In another figure the chorda tympani is shown passing above the first pharyngeal pouch. The vitelline artery and vein are shown in Fig. 176 passing to their destination outside the mesentery of the small gut, while the relations of the Wolffian duct to the ureter differ in Figs. 207 and 212. Indeed, the error in Fig. 207 would make the transformation which is shown in the succeeding figures impossible to understand. The changing relations of the suspensory ligament of the gonad to the metanephros shown in figures dealing with the urogenital system can do little but confuse the observant reader. In Fig. 330, based on Macklin's diagrams, the tympanic bone is indicated as a cartilage bone, while in the succeeding figure it is correctly depicted as a membrane bone. Correlation between the figures and the text is in many places unsatisfactory. Structures such as the paracondyloid process, ala hypochiasmata, alicochlear commissure and polar cartilages are figured and labelled but receive no mention in the text and fail to appear in the index.

The account of early human developmental stages is excellent and constitutes one of the most valuable features of the book. Many details of known early human embryos are tabulated and recorded. This is a field in which at least one of the authors can speak with considerable authority and gives a valuable summary of the formation of the germ layers and implantation as it is now known. The sections on the lymphatic system and on teeth could with great advantage be enlarged and elaborated. The development of the heart is clear and well written; but it is a little surprising to note the omission of the term infundibulum of the right ventricle both in the text and index. Speaking of this part, Keith said, "The importance of recognizing the bulbus cordis as a separate constituent of the heart will be realized when it is remembered that 95% of the cases of congenital malformation are the result of its imperfect transformation to form the infundibulum of the right ventricle of the heart". It would appear that it is impossible to lay too much stress on this part.

Congenital abnormalities and disease are considered briefly, while the possible mechanisms of malformation, twinning and monstrosities are discussed.

The choice of epiloia as an example of a purely ectodermal disease is misleading, both on account of its rarity and of the mesodermal tumours in the dermis, heart and kidney which seem to co-exist in a great majority of the cases.

Most text-books of human embryology suffer from one serious defect, namely, the inadequate picture which is conveyed of that most interesting of all newborns, the human babe at birth. This book is no exception. Ballantyne's account in that infrequently read book "Antenatal Pathology and Hygiene" still remains one of the best and most concise. Embryology should not only help the student to understand adult anatomy but also neonatal anatomy and physiology, upon which so much depends. The fact that the fœtal and newborn kidney is lobulated is not mentioned in the text of this book, though it is frequently so depicted in the figures, while the term fontanelle does not appear within its covers.

The book is beautifully produced. Typographical errors are few and the photographs and figures are well reproduced. It is a credit to the publishers that they find themselves able to offer such a profusely illustrated volume at so reasonable a price. The student will undoubtedly appreciate the excellency of the production, as well as the concise presentation of the many and important aspects of human embryology now made available to him.

D. V. Davies.

FRANÇOIS MAGENDIE (1783–1855)

François Magendie

Pioneer in Experimental Physiology and Scientific Medicine in Nineteenth Century France. By J. M. D. Olmsted. Pp. xvi+290+1 plate. (New York: Schuman's, 1944.) 5 dollars.

PROF. J. M. D. OLMSTED has followed up his excellent life of Claude Bernard with one of François Magendie, Bernard's teacher and one of the great figures in the rise of scientific medicine. Trained in Paris during the period of the Napoleonic Wars, Magendie worked in a period when medicine began to discard the traditions of the eighteenth century and to depend on more critical and exact observation and experiment. Bichat, Laennec and Corvisart were his seniors, and Flourens and Le Gallois his contemporaries. French medicine was in the ascendant, and Magendie, professor at the Collège de France from 1831, contributed to its development by his work in physiology and pharmacology and by his uncompromising criticism.

Magendie was before all things an experimental physiologist, and his name survives in the 'Bell-Magendie law' of conduction in the spinal roots and in the 'foramen of Magendie', the opening through which the cerebro-spinal fluid passes from the interior to the exterior of the brain. Probably the Bell-Magendie law is rightly named, for Charles Bell, the brilliant Scottish anatomist, and François Magendie both had a hand in its discovery; but Magendie always felt that the main credit was his and did not hesitate to say so. Prof. Olmsted's critical account of the long controversy shows that he had some reason for his claim, since his were the decisive experiments. But his contemporaries favoured Bell, and Magendie's quarrelsome habits may have made them glad to do so.

In medicine Magendie remained the experimental physiologist. With his lack of respect for tradition, he found much to overthrow though he had little to put in its place. He had no use for copious bleeding and purging, the established treatment of the time, though his internes were so distressed at this neglect of his patients that they sometimes bled them without his knowledge. His studies of the effects of drugs on animals (the beginnings of experimental pharmacology) did not encourage him to use more than a few well-tried medicines, and he was often content to leave the disease to run its course. Flourens wrote of him: "To young doctors he was fond of saying 'You have not tried doing nothing yet. . . . More often than not we cannot discover the cause of a disease. Our only function is to assist Nature, which always tries to restore the normal state, by refusing to hinder her; we can hope only sometimes to be skilful enough to aid her'." But his patients relied on him none the less, and he was far kinder to them than to most of his scientific colleagues.

Nor did Magendie neglect to look for the causes of disease. He made a special journey to Sunderland in 1831 to report on the outbreak of cholera there. He was appalled at the wretchedness, filth and poverty of the houses, but argued that the disease was not contagious. His views on contagion seem, in fact, to have been based on the belief that a disease could not be contagious if he himself had been exposed to it and had not been infected. He had certainly exposed himself, in Sunderland and afterwards in the Paris epidemic of 1832, where he worked day and night at the Hotel Dieu with a small band of internes and nurses.

Magendie's views were certainly wrong sometimes, and he would not admit that they were until he had seen the experiment which disproved them. He was intolerant, resented criticism, made enemies and was regarded by many as a monster of cruelty for his vivisection of animals. But he was fearless and honest, and medical science owes a great deal to his deliberately sceptical attitude, forcibly maintained and upheld by his great authority as a physiologist. Prof. Olmsted's biography is careful, well-balanced and interesting. It is to be hoped that he will write more of this period which he knows so well.

E. D. Adrian.

HAY-FEVER PLANTS

Hay-fever Plants

Their Appearance, Distribution, Time of Flowering and their Role in Hay-fever, with special reference to North America. (Plant Science Book, Vol. 15.) By Roger P. Wodehouse. Pp. xxvi+245. (Waltham, Mass.: Chronica Botanica Co.; London: Wm. Dawson and Sons, Ltd., 1945.) 4.75 dollars.

FOR a plant to be an important cause of hay-fever it must shed its pollen freely, must produce large amounts of pollen, must grow in great abundance, and must have active allergens in the pollen grains. Most wind-pollinated plants satisfy the first condition, but anemophily and entomophily offer little guide to the second. Relative abundance is of immense importance as a distinguishing factor between species of great and small importance in hay-fever; thus only about thirty-five species of grasses out of the thousand or so in the North American flora are important hay-fever plants. Lastly, the allergic qualities of species also differ widely, appearing with fair constancy in the following families : Gramineæ, Compositæ, Chenopodiaceæ, Amaranthaceæ, Plantaginaceæ, Polygonaceæ, Betulaceæ, Fagaceæ, Ulmaceæ, Moraceæ, Juglandaceæ, Salicaceæ, Aceraceæ and Oleaceæ.

If to these considerations we add the differential susceptibilities of patients to various types of air-borne pollen, the immense variation in local occurrence of the species concerned, and their various times of flowering, it will be apparent how large and complex a field of botanical inquiry lies behind the scientific study of the causes of hay-fever. Such study has of recent years made great progress in the United States, and one of the foremost research workers on pollen characterization and identification, Dr. R. P. Wodehouse, has now published a useful and timely summary of present knowledge of hay-fever conditions in that country.

An introductory chapter explains the origin of air-borne pollen and describes the chief methods now employed in estimating the pollen content of the air, filtration, the air-centrifuge, and gravitational settling, combined with microscopic identification. It is interesting to have the first tentative estimates of the minimal pollen doses which will produce hay-fever symptoms. For the ragweed (*Ambrosia* spp.) this appears to correspond with a pollen frequency of about 200 grains per cubic yard of air, or a daily inhalation of about 4,000 grains.

Subsequent chapters give brief descriptions of all the species now recognized as concerned, or possibly concerned, with hay-fever in the United States, with accounts of form, habitat and flowering season, illustrations of the plants, and full description and illustration of the pollen grains.

Lastly there follows a valuable analysis of all the recorded data for the United States treated on a basis of twelve geographical regions, for each of which there is given a comprehensive chart illustrating the frequency and flowering season of all the hay-fever plants. From this information both clinician and botanist will derive much help. We can see at a glance how in the north-eastern States there are three phases of hay-fever in the year—the unimportant early spring phase of tree pollen, the important early summer grass pollen phase, and the very important late summer ragweed pollen phase. This contrasts strongly with conditions in the southern States, where the long growing season gives many continuous months of hay-fever conditions to which many pollen types contribute. In this section we find also discussed how the weediness of undeveloped building estates makes for bad hay-fever conditions, and how forest cover and maritime situation offer good conditions suitable for hay-fever resorts.

It is very striking to the English botanist to observe that most of the grasses which are serious causes of hay-fever in the United States are those introduced from Europe, such as *Anthoxanthum odoratum*, *Poa pratensis*, *Phleum pratense*, *Agrostis alba* and *Dactylis glomerata*, while with them is associated *Plantago lanceolata*. Presumably the reason for this is that these are all weeds or cultivated grasses now abundant around the big population centres which are comparatively out of reach of pollen borne by the wind from the prairies. Otherwise one would not expect the native prairie grasses to be so overweighted in effect.

It is to be hoped that this book will encourage much similar work, not only in the United States, but also in Great Britain, where hitherto only Hyde and Williams have made significant headway in this direction.

H. GODWIN.

METHODS IN CLIMATOLOGY

Methods in Climatology

By Victor Conrad. Pp. xx+228. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1944.) 22*s*. 6*d*. net.

In this book, Dr. Victor Conrad, formerly head of the Austrian Meteorological Service, and now research associate in climatology in Harvard University, gives an outline of methods of treatment of observations, as distinguished from results of the treatment.

The book is in four parts, the first dealing with the general methods of statistical discussion, including the evaluation of frequency distributions, the mean, median, mode, etc., the fitting of curves to numerical data, the smoothing of data, and the essential formulæ of harmonic analysis.

The second part deals with the representation of characteristic features of different elements. Thus under the heading of temperature we find the discussion of the relation of the mean of two or three observations made at standard times to the 'true mean', which is the mean of 24-hourly observations, and the evaluation of spells of weather which satisfy certain conditions. Rather similar technique is applied later to rainfall measurements. The methods of evaluating resultant wind velocity from records of the velocity and direction, and the resultant wind direction from the frequencies of the directions alone, are discussed in a separate chapter. All these topics are relatively simple and could perhaps have been treated more briefly.

While there are frequent references to original papers, the author now and again fails to explain an important point. For example, on p. 111 he gives formulæ for the evaluation of the drying power of the air, the effect of the wind speed, v, being represented by a factor $F(v)$. A table of values of $F(v)$ is given for a wide range of values of v, presumably from a paper by Knoche. The reader would have profited from a hint as to the form of the function $F(v)$, particularly in view of the fact that a few pages later, in discussing cooling power of the air over a wet surface, the author gives a very different function of v in his equations.

The third part of the book deals with methods of spatial comparison. Methods of testing relative homogeneity of observations, and of the reduction of climatological averages to a uniform period, are briefly treated. Formulæ for computation of the coefficient of correlation, and of the regression coefficients, are given later. Here the reviewer felt that emphasis should have been laid on the practical forms for computation, which are $r=\Sigma xy/\{\Sigma x^2.\Sigma y^2\}^{\frac{1}{2}}$ and $b=\Sigma xy/\Sigma x^2$ respectively, and not $r=\Sigma xy/n\sigma_x\sigma_y$ and $b = r\sigma_y/\sigma_x$. The methods of anomalies, the use of wind roses and stream-lines are briefly discussed.

The fourth part deals with climatography, or the presentation of a complete picture of the climate of a region. This part is of interest in that it brings into prominence a number of features of climate which are frequently overlooked; but it does not sufficiently emphasize the fact that a satisfying description of a climate should deal, not only with the monthly means over a period, but also with the variability from the mean.

This book, which is in general simple in its treatment of the questions discussed, will be a help to many a beginner in the subject.

Post-War Educational Reconstruction in the United Nations

21st Educational Year Book of International Institute of Teachers College, Columbia University. Edited by I. L. Kandel. Pp. ix+341. (New York: Bureau of Publications, Teachers College, Columbia University, New York City, 1944.) 3.70 dollars.

THIS book is of special interest at the present time, when attention is being directed to the future of education, and to the prospects of a new start, based upon the ideals for which the War has been, and still is being, fought. The havoc wrought by the aggressors on educational systems in the occupied countries is here described; the problems that confront each of the countries are discussed; and the programme for reconstruction in the years following the final victory of the United Nations is presented. The book contains articles on Australia, Belgium, Canada, China, Czechoslovakia, England, France, Greece, Italy, the Netherlands, New Zealand, Norway, Poland, Scotland, the Union of South Africa and the United States. The omission of an article on Soviet Russia is due to circumstances over which the editor had no control; and the absence of an article on Yugoslavia reflects the uncertain political situation in that country when plans for this volume were being made.

This is the twenty-first volume of the Educational Yearbook of the International Institute of Teachers College, Columbia University. During the whole period the Yearbook has been edited by Prof. I. L. Kandel, who now has to make the melancholy announcement that this volume will be the last in the series. The news will be received with great regret by students of education in many lands who have derived both pleasure and profit from the Yearbook. The editor places on record his indebtedness to the Rockefeller Foundation and the Carnegie Corporation of New York, which made publication possible, to the willing co-operation of contributors, and to his able secretary, Miss Gilroy. To all these must be added Prof. Kandel himself, the moving spirit of the whole enterprise.

The Blackbird

A Contribution to the Study of a Single Avian Species. By A. F. C. Hillstead. Pp. 104+19 plates. (London: Faber and Faber, Ltd., 1945.) 8*s*. 6*d*. net.

IT is wrong, to my mind, to tell a child not to be cruel to animals; it puts the very idea of cruelty into his mind, and the living creatures remain animals, or even beasts, for him. He had better grow up among the mouse-people and the sparrow-people and the pussy-cat-people, and all the other friendly people who share the world with each other and with him. This is the wholesome spirit in which Mr. A. F. C. Hillstead writes about the blackbird, in the company of which he has lived for years, until he knows him body and soul. There is not a thing in his little life which Mr. Hillstead has not studied and described: his song, his 'territory' or law of landed property, his courtship and nest-building and care of his young, his migrations on holiday jaunts, his general intelligence, and all the diverse occupations of his livelong day. Mr. Hillstead has much to tell under all these heads, and more besides. The blackbird is no world-wanderer, like stork or swallow, but he does love a change of air; he likes to 'go places', like civilized man. He comes across the Channel to share our milder, insular winter; he is partial to Ireland; he cares little for Devon, and openly dislikes Cornwall, strange to say. His song is described with full sympathy and comprehension; "by and large, it has no equal; there is nothing to touch the rich flute-like tones which are so essentially British".

The whole story is illustrated with photographs by bird-loving friends. These are wonderfully beautiful; they show all sorts of situations of the nest, and all sorts of occupations of the bird. In short, we have here, to the life, our old friend "so black of hue, with orange-tawny bill"; and his wife and children, and his house and home, and everything which is his. D'ARCY W. THOMPSON.

Sun Compass

By Francis Chichester. Pp. 10+Compass. (London: George Allen and Unwin, Ltd., 1944.) 5*s*. net.

THE sun compass is designed for use anywhere in a belt round the world within two hundred miles north and south of a line from Birmingham to Berlin. Knowing the date and the local time, a simple setting of the sun compass enables one to take the sun's bearings to an accuracy of about 2°, and with practice an accuracy of 1° is possible. A rotating disk has the months marked with dates which vary from six to twenty days. Thus September 16–22 is included in one date, June 1–21 in another, and so on, and a 'model sun' for each of these periods is marked on the disk. On a transparent graticule are marked the hours from 4 to 20 and also curves showing the sun's bearings from 50° to 300°. The bearings are given for every 10°; but it is easy to interpolate to an accuracy of about 1°.

On the back of the card there is a compass rose by which bearings other than those of the sun can be obtained. This involves nothing more formidable than setting up a pencil on a degree circle, so that the shadow of the sun falls on the centre of the compass rose, which is then rotated until the shadow cuts the degree scale at the desired division. The maximum error that can occur at places 3° north or south of the Birmingham-Berlin line is 3°, but this takes place only at midsummer and even then only at certain times in the day. It seems possible that there may be a demand for this very convenient instrument (it measures 5½ in. by 5 in.) for other latitudes. Having checked some of the results, using rigorous formulæ and four-figure tables, it is surprising to find the high degree of accuracy obtained over the range of latitudes. M. D.

The Science of Nutrition

By Prof. Henry C. Sherman. Pp. xi+253. (London: Oxford University Press, 1944.) 15*s*. net.

THIS is a book about nutrition for the layman. Prof. Sherman describes the three main functions of food as first, provision of energy; secondly, supply of structural material for the growth and maintenance of tissue; and thirdly, the provision of substances which maintain the body's self-regulatory system and physico-chemical balance in tissue.

On this basis is built an excellent survey of the recent developments in the science of nutrition in its personal and economic aspects and applications. Purely scientific terms and descriptions are kept to a minimum, but a selected bibliography is provided for those readers whose interests go beyond mere broad information. The wide scope of this work is indicated by the inclusion of a summary of work on 'tagged' atoms in the study of metabolism.

RADAR IN WAR AND IN PEACE

By Sir ROBERT WATSON-WATT, C.B., F.R.S.

It is customary, but not invariably wise, to preface an account of a new subject with some attempt at a definition. There being no part of the problem more difficult than accurate and condensed definition, this custom makes the whole subject look more difficult than it really is. For this reason the immediately following section of these notes on radar might well be annotated, as in some prescribed text-books, with the remark "May be omitted at a first reading".

On Defining 'Radar'

To devise, and to interpret, an adequate definition of 'Radar' would be more laborious than profitable. The group of varied and flexible but intimately related techniques which have grown from a common stem of R.D.F. or radiolocation in Great Britain and radar in the U.S.A. have it in common that they involve essentially a measurement of distance, inferred from a relative time-delay and an assumed or known speed of travel of radio waves. But they have much more in common, and they are far from being merely radio range-finding systems. They might not have been achieved without Appleton's classical range measurement on the ionosphere; they would not have been practically useful without Breit and Tuve's powerful tool of the radio pulse, which carried Fizeau's method out of the optical laboratory into the upper air.

At the least, a radar system must provide an unambiguously associated pair from the three co-ordinates required to specify the position in space of the material object to be located by radio means, and must present these co-ordinates in a form convenient to the user. It should and normally does measure the third co-ordinate (usually stated as flying-height) in the case of aircraft, and it frequently gives additional information about identity, numbers, speed in line of sight, and so on.

It would be pedantic, unrealistic and unhelpful to restrict 'radar' to the "location of an object without active co-operation from that object". The radiolocation of friends will, happily, be a far more general practice than the search for enemies, and active co-operation from the friend should not be ruled out as 'not cricket'. Nor should the emphasis be on 'an' object. The very essence of radiolocation, alike for war and for peace, is that it began with a determination to achieve something more practical than one of several possible systems which could locate 'an' aircraft alone in space, or could continue to locate an aircraft once an initial position was known, to the neglect of all the other aircraft in the sky and of the initial pick-up problems.

It would be artificial and misleading to confine the adjective 'radar' to systems involving the reflexion of radio energy from the object to be located, or even to the return of energy from the object towards the primary radiator. The most generally installed radar equipment of all was the 'Gee' receiver, which enabled the air navigator to determine his position by measuring the relative times of arrival of radio pulses emitted synchronously from three ground stations. The techniques involved in this 'one-way traffic' system of pulses, travelling from ground to aircraft or from shore to ship but not back, are quite inseparable from the techniques used in the 'H' and 'Oboe' systems, in which the primary radio pulses 'interrogating' the mobile craft automatically release from it a series of reinforced, coded, and conveniently frequency-displaced reply pulses, which travel back towards the primary radiator. And the techniques of all these, and of the I.F.F. system from which 'H', 'Oboe' and radar beacons grew, are in turn quite inseparable in general conception and broad execution from those which are used to extract somewhat lower accuracies at somewhat shorter ranges from the somewhat less informative radio echoes returned from a non-co-operative aircraft.

So in practical life radar is a group of techniques which enable the position of one object among many to be measured by radio means, involving essentially the measurement of relative time-delays and thence the total paths or difference of paths, in the travel of suitably labelled radio waves between the object to be located and the radio station or stations (which may be transmitting, receiving or receiving-and-retransmitting stations) which provide reference points for the location. The 'labels' attached to the radio waves may be a controlled change of frequency, as in the Appleton foundation experiment in radio range-finding, or a controlled change in amplitude, of which Breit and Tuve's pulse technique is the almost universal application.

The Pulse Technique

The pulse technique has attained this universality because it satisfies a number of special needs simultaneously. The beginning or 'leading edge' of the pulse marks a packet of energy which can be re-identified after the vicissitudes of travel, thus permitting accurate measurement of time of travel, and the end or 'trailing edge' marks the beginning of an invaluable clear period in which the radar echoes or response signals can be received free from the overlaying and interfering effect of the primary signal. In modern pulse technique, pulses which may be very brief indeed are sent out at a very accurately controlled recurrence frequency, and displayed on the equally accurately synchronized time-base of a cathode-ray oscillograph. This gives a cumulative preference to the slowly changing pulse-responses over the random noises occurring along with them, since the successive responses are more or less accurately superposed while the noise is spread more or less evenly over the background. The interval between primary pulses is preferably made just greater than the time-delay of the response from the greatest distance to be sounded. The time base then becomes a range-scale, with its zero at the leading edge of the primary pulses, and it can be made linear in time and range. Care must, however, be taken that echoes or responses received after a time-delay greater than that between primary pulses are not read as coming from a distance less by one or more whole pulse-periods than their true path. Finally there is a considerable advantage in discrimination to be attained by using the pulse-recurrency frequency as a coding characteristic of the stations concerned, and by additional coding by pulse-width or multiple pulse-spacing, or both. These advantages of the pulse system are bought at that price in increased width of frequency channel occupied which is the inescapable price of high information-carrying capacity.

The superposed successive pulses returned from any one reflecting or responding object can be treated as a continuing signal coming from that object, unmixed with others of different time-delay, and can thus be subjected to standard processes of direction-finding, in azimuth and elevation, independently of the corresponding series of responses from more or less adjacent objects. And if the responses come from closely spaced objects, such as a tight formation of aircraft, the beating which results from their incomplete separation can be used as a means of estimating the number of objects thus incompletely resolved.

The First Steps

When it became distressingly obvious that it would be important to detect and locate enemy aircraft while they were still far from our shores, the high probability that a single aircraft could be located at a hundred miles, and the possibility that it could be detected at two hundred miles, was readily demonstrated by simple arithmetical process, supported by a crude experimental demonstration at short range. The arithmetic was easier than the consequent decision, for it pointed to an engineering efficiency, in a single determination, of the order of one in 10^{17}. The joint operational and technical decision that it was alike worth while and practicable to utilize this low-efficiency process transformed an idle dream, often conceived and always dismissed, into a decisive weapon of war.

But there were many technical difficulties in the transformation. No distances less than thirty miles had ever been measured by radio range-finding; targets separated by less than fifteen or twenty miles would not be resolved by the then existing technique. These two profound and indeed prohibitive limitations must be removed by a very drastic shortening of the emitted pulse, from the then current durations of about half a millisecond to durations of five or ten microseconds. This shortening must be accompanied by a great increase in the peak power emitted, and by a 'squaring' of the pulse shape. A sharp leading edge was vital to accurate range-finding; a long trailing edge was fatal to echo separation. The receiver and its associated aerials must give good response over the wide frequency band occupied by such short steep pulses, and it must also be immune from paralysis by the enormously powerful impulses from a transmitter a few yards away; many other defects in senders and receivers had to be cured. No direction-finder of adequate sensitivity existed; it had to be developed. The effective measurement of flying height depended on specially favourable topography; sites with a favourable foreground must be combined with accessibility and bearing capacity for heavy towers. Even on the most suitable sites the resulting data had to be corrected against calibration flights and had, after correction, to be put in a form convenient for immediate communication to the user. How the technical problems were solved must be told in detail elsewhere; the broad operational results have already been outlined in the daily Press. Here it is important to emphasize the milestones in radar technique, and how they were set up.

Milestones

When the more obvious of the difficulties just enumerated had been surmounted there remained those due to interference between the rays propagated directly between ground station and aircraft, and those reflected, with an almost complete reversal of phase, from the ground. It was the presence of the reflected ray that made height-finding practicable; but this one convenience was a part compensation for great inconveniences. The phase reversal meant that the interference pattern between direct and ground-reflected ray had a minimum in the horizontal direction, so that low-flying aircraft could come close inshore before detection. The only cure for this was the adoption of much shorter wave-lengths, so that the bottom lobe of the vertical polar diagram could be pushed lower without the use of prohibitively tall aerial systems.

The higher minima in the interference pattern were still at such angles that there were inclined lanes down, or to some extent across, which aircraft could fly unlocated, and these gaps in coverage had to be filled by the use of aerials of different height, with a non-coincident interference pattern, and by switching frequently from one aerial height to the other.

The attainment of high powers and adequate receiver gain on one-and-a-half metre wave-lengths allowed low cover to be established; but it permitted also the setting up of the third milestone in radar. The aerial system for such wave-lengths could now be rotated mechanically, and gave a comparatively narrow beam. By electrical beam-swinging the beam could be moved by a few degrees, and by matching amplitudes of response with the beam in its two positions the target could be located in azimuth with an accuracy some twenty times greater than by the previous methods. The inaccuracy of bearing fell from one or two degrees to five or ten minutes of arc. This was indeed a landmark in the history of precision measurement by radio.

Concurrent work on improved accuracy in the time-delay measurement was in train, and it was soon (in fact in 1938) established that the operational range-accuracy of the monostatic radio range-finder was, against quick-moving aircraft targets at least, higher than that of the monostatic optical range-finder. Errors of about twenty-five yards at heavy anti-aircraft gunnery ranges became standard.

One of the greatest steps in radar technique was the development of the Plan Position Indicator. Initially the time-base of the cathode ray oscillograph had been a fixed diameter of the tube-face, and the radio response or echo made an indentation (or 'blip' !) transverse to this line. But when the rotating antenna was introduced, and the radiation was confined to a comparatively narrow rotating beam, it became practicable to make the time-base a radial one, with its zero at the centre of the tube-face, and to rotate it synchronously with the antenna. If now the received signal were used to give brightness modulation of the cathode-ray beam, a response was displayed as a bright, though not very small, sector of a circle, the inner edge of this sector measuring the range and the mid-angular point of the sector the bearing; the width of the sector was of course governed by the sharpness of the radio beam. Thus automatically the rotating radial time-base gave in map form a plan display (with slant range used instead of horizontal range) of the positions of responding objects. This device, first used in the controlling from the ground of night-fighters, was of the utmost importance in the airborne and shipborne radar of the war against the U-boat, and in the aids to the bombing of invisible targets which were variously called 'H2S', the 'gen-box', 'Mickey' and the 'Magic Eye'.

The greatest revolution of all, however, was the success of the campaign for centimetric wave-lengths. It had long been clear that the major defects of airborne radar, and many of those of ground radar, were curable only by the use of an extremely fine pencil of radiation scanning the area to be explored. Such a pencil could only be formed by an antenna and reflector system having an aperture of many wave-lengths, and this could only be fitted in aircraft if the linear dimensions and weight were kept down by the use of wave-lengths less than ten centimetres. The precision with which individual targets could be located, the clarity of display, the separation of responses from two or more targets, and the reduction of the very serious overlaying effect of responses from fixed objects were all immediately dependent on the attainment of centimetric working. There were some associated advantages in reduction of the enemy's power to interfere with the full enjoyment of radar facilities.

How centimetric radar came is so closely associated with the general story of the organization of scientific effort on radar that it is desirable to look next at that story.

The Spiritual Ingredients

The most important thing about the British development of radiolocation as an instrument of war is not that it happened, but that it happened at the right time. The essential difference between the British effort and the most nearly corresponding effort in other countries is to be sought in those intangible factors which assured to us, at each stage in development, an adequate (though often a no more than adequate) margin of time for meeting the successive crises of the War.

It cannot be too often or too firmly stated that the victory over Germany was essentially a victory of the spirit. No technical devices can turn the scale of war save as tools of the spirit. Nor is there, indeed, any real gap between spirit and material, though the very mechanical perfection of our new technical devices may hide the vital fact that they are not only the tools but also the products of the spirit. Radiolocation is perhaps the best of all examples of the interaction of spirit and technique in the forging of a decisive weapon of war. But its origins in the spirit of science may be temporarily lost to view behind its successes. The curiosity-value of its devices, the wealth of its applications to all forms of warfare, and its spectacular victories may dazzle the casual observer.

Radiolocation was the direct, but in no wise the predestined and inevitable, fruit of pure research. Its beginnings lay in the work of those who laboured to understand more of the things that happened in the earth's atmosphere. Its later developments, and much of its technique at all times, were due to those who sought the inner secrets of the structure of matter.

Britain was a prominent leader in those pure researches into the physical processes of the ionosphere and of the lightning flash which were, indeed, directed towards the improvement of radio communications, but which were of an enlightened width and depth, not closely trimmed to immediate practical ends. These researches were State-aided, but most generously and most lightly State-controlled. The Department of Scientific and Industrial Research had, through the vision of its first Minister, A. J. Balfour, and of its successive administrative heads, Sir Frank Heath, Sir Henry Tizard and Sir Frank Smith, established a unique position for its Radio Research Board, founded and nurtured by the gentle wisdom of Admiral of the Fleet Sir Henry Jackson. Among the Board's contributions to the international stock of fundamental knowledge and to the international store of radio technique, none was more important than those due to Dr. E. V. Appleton, whose radio researches it supported from its foundation until the time when he succeeded Sir Frank Smith (himself a dominant figure in the scientific work of the Board) as Secretary of the D.S.I.R., and became Sir Edward Appleton. It is morally certain that without the peaceful pursuits of the Board in general, and of Appleton and his colleagues in ionospheric research in particular, radiolocation would have come too late to have any decisive influence in the War.

The Radio Research Board had trained a team of young research workers encouraged to see and explore the wide open spaces between the Morse key and the loud-speaker. They were to remember the needs of the radio user, but to probe to the heart of the processes rather than to apply palliative dressings. They were to be pathologists rather than physicians; to be physiologists and even morphologists rather than pathologists. Their vision and imagination were to be turned in the general direction of application, but they were to take neither narrow nor short views.

The scientific staff of the Air Ministry reviewed in 1934 the prospects of aerial warfare. They were profoundly disturbed by the lack of any effective means of defence against the fast military aircraft of the day. On their advice, the Secretary of State for Air sought the counsel of three distinguished 'outside' scientific workers of deep knowledge and wide experience. They in turn suggested that one aspect of the problem should be discussed with a member of the Radio Research Board's team.

As an official document has recently said: "This contact between a user Department with a great need, and a Department which had fostered scientific discovery not wholly directed towards specific needs, was perhaps one of the most important events in our history, and illustrates the need for fostering scientific research in all fields and for making the needs of the State known to those who are engaged on scientific research".

It was a characteristic and natural step in this train of enlightened reviews of general needs rather than particular prescriptions, that the radio researcher brushed aside the problem directly posed, replacing it by a quite different and far from novel problem, for which he proposed a novel solution. The solution was novel, not because it had not been glanced at qualitatively on other occasions, not because it contained any intrinsically novel element, but because it was a quantitative synthesis, a judicious mixture of old ingredients, each ingredient to be modified and refined for the new purpose, and adapted to the complexities of an operational problem far more involved than those of the laboratories—even of the open air laboratories—in which the ingredients had been evolved.

But again it must be said that the basic ingredients of radiolocation were in fact the spiritual ingredients, the wisdom that integrated the scientific advisers into the Air Staff in the handling of its day-to-day worries, the judgment that assessed the relative priority of these worries, the courage of all the participants—courage in the small band of "good but not first rank" (the description is their own) men of science who made firm promises out of their exact knowledge and their imaginative enthusiasm; courage in the men of science who recognized the scientific and operational validity of promises made on a one in 10^{17} basis, courage in the officers who staked some millions of pounds of public money and revised the air defence system of the country on the paper promises of a "bunch of scientists", the exploits of a "rather ancient lorry" near Daventry and the not unqualified successes attained in a few tentative air exercises.

That success—a success which even in the first trial of strength in 1940 made the difference between a free and an invaded Britain—was achieved was due to those same influences which governed the acceptance of the gamble. The most significant factor in the story of radiolocation was not the technical skill packed into its boxes, was not the operational skill with which they were used. It was the unprecedented and unprecedentedly productive interplay between scientific and operational minds, which carried the basic technique from its first defensive application in an early warning system through more actively defensive phases to a wealth of offensive applications which had a decisive effect in every major phase of the War.

When radiolocation has taken second or third place to future novelties in the military art, this intimate co-operation of scientific and military minds will remain as the real secret weapon in the British armoury, as something which grew to full vigour with radiolocation, at once a source and a product of that successful development. Nowhere in the councils of the United Nations or of their enemies—and those concerned in developing radiolocation have been at some pains in recent months to verify this last point—has there been a parallel to the practice followed from the first days of radiolocation research. The Air Marshal took advice from the junior scientific officer on how to make war, and the laboratory assistant was told by the Admiral why physics has sometimes to give way to psychology in the planning and conduct of operations. The soothing fiction of an operational requirement stated by an all-wise staff, and unquestioningly satisfied by a docile and technically expert developer, has no place in the history of the most versatile technique of the War. The proud and affectionate title of "Boffin" conferred on the scientific developer by his military colleagues and co-workers is earned only by a man in whom technical expertize is matched by operational understanding and indomitable zeal, allied to the peculiarly scientific virtues of inquisitiveness, impatience, intolerance and insubordination.

The fruitful co-operation was not confined to the origination and development of technical equipments and systems. It extended to the selection and training of personnel to operate and maintain the systems, to the evolution and practising of tactical methods based on the systems, and to the whole complex of technical, tactical and logistic problems involved in introducing new scientific devices into heavily engaged operational formations.

The over-riding demands of secrecy limited the size of the team and the facilities that could be devoted to radiolocation in the 1935–39 period. Not the least of the merits of that limited team were their technical restraint and their ruthless objectivity, their refusal to explore at once the innumerable avenues of development opened by the new art, their insistence on the sacrifice of refinements, elegances and versatilities to the one desperate need for "something to be going on with". They never turned aside from their cult of the third best—"the best never comes, the second best comes too late".

Easter 1939 saw the opening of a continuous watch—sustained unbroken for the next six years—by the radar stations of the east and south coast; it saw also the reinforcement of the research and development teams by the cream of the physical research laboratories of the country. The ninety physicists who spent the spring and summer of 1939 in the coastal stations devoted their first war-time efforts to meeting the needs and exploiting the possibilities which suggested themselves in their first scrutiny of radar at work. Further strengthened by transfers from other groups, the greatly augmented team brought to the work intellectual qualifications, research experience, depth of fundamental physical knowledge, imagination, initiative, versatility, enterprise and enthusiasm, inquiring and critical faculties, of quite unique order. The dreams and aspirations of the 'founder members' were rapidly fulfilled and surpassed, new dreams were converted to achievements, and the traditions of constructive debate between General and junior scientific worker and of inextricable interweaving of contributions from operational officer and boffin were cherished, maintained and extended.

The newcomers, knit into a large and powerful organization, with facilities better proportioned to their needs than ever before in research for military purposes, came from other fields besides pure physics. Chemists, physiologists, general biologists, dons and schoolmasters were united by certain basic characteristics common to all branches of science. The habit of measurement, classification, comparison, and orientation in the light of defined principles, the isolation of those changes in behaviour which are due to the variation of one identified factor from those due to other factors, the stringent assessment of statistical validity in measurements, are of the creed of all men of science in all fields. A sturdy refusal to take refuge behind chance and accident, a firm hatred of the creed of the 'magic box', make the boffin the sworn enemy of the 'gremlin'. A stern exclusion of emotion from the method of science is allied with a fierce flame of emotion as the motive power behind the application of that method. Above all, a religious conviction that all facts are good facts, that suppression of the known and measurable truth is the supreme sin, governs and explains the determination of the man of science to drag every strategic and tactical skeleton out of the cupboards of the Commands, so that it may either be reclothed and revivified or be decently interred.

From this fervent objectivity, backed by the highest technical skill ever organized into a single team, and by a remarkable organization for quick production, came the successive devices that turned the tide of battle in successive phases of the War. They were vital to the defeat of the day bomber and the night bomber attacking London and other British cities and towns. They drove the enemy surface ship from the Straits, the North Sea and the oceans of both hemispheres. They beat the U-boat in the Bay of Biscay and in the Atlantic. They foiled the 'flak' gunner in the Ruhr. They penetrated the fog and cloud cover that was the best anti-aircraft aircraft defence the German cities ever had. They baffled the night fighter which strove to make good these lost defences. They silenced the coastal gunner on the

Normandy shore. And, by aiding the airborne forces and the tactical air forces supporting the armies of liberation, they contributed to the defeat of the last Panzer and infantry defences of the crumbling Reich.

The Centimetric Revolution

The demands for adequate transmitter power and receiver sensitivity on centimetric wave-lengths had grown more and more insistent from the time they were first voiced by the radar team of 1935, and the ninety 'scientific observers' on the chain in 1939 included those best qualified to perceive the intensity of the need and to devise the means for meeting it.

Under the inspiration of Prof. M. L. Oliphant a team at the University of Birmingham provided the essential element in the solution. Dr. J. T. Randall applied the resonant-cavity technique to the relatively ineffective magnetron of pre-war days, and made of it a radically new and immensely powerful device which remains the heart of every modern radar equipment. Dr. R. W. Sutton, of the Admiralty Signals Establishment, matched it with an equally novel receiving valve, the Clarendon Laboratory team made a vital contribution to the efficient use of a common aerial system for transmission and reception of radar pulse signals, and centimetric radar for ground, ship and airborne use was at hand. Floodlighting and wide-beam systems remained an essential part of the whole radar complex; but the fine pencil scanning systematically and point by point the whole area of search alone sufficed to paint the fine detail of target areas, to avoid the smudging over of each element by the response from adjacent or more remote elements, to give adequate 'illumination' of the extremely low flier or the surface ship by coast-watching stations. And apart from permitting fine-beam formation, the very high frequency permitted a corresponding improvement of discrimination in depth, by allowing pulses of duration much under one microsecond to be formed by the transmitter and reproduced comparatively faithfully by the receiver. Only at frequencies of, or above, three thousand megacycles per second does the bandwidth occupied by such short pulses constitute a sufficiently small percentage of the central frequency for good pulse-shaping at sender and receiver to be attained.

These were the foundations of the techniques which gave the night fighter an A.I. set in which the returns from the ground no longer overlaid those from the bomber under pursuit whenever its range from the fighter exceeded that of the nearest ground, so that the maximum effective range of the A.I. set was no longer, as before, the flying height of the fighter. They gave the searcher for the surfaced U-boat, in destroyer, corvette and aircraft, the means of locating a periscope at several miles and a normally surfaced U-boat at tens of miles, and prevented the U-boat from getting, before he was driven from the sea, that early warning of pursuit which he derived from listening sets on metric wave-lengths. They gave the anti-aircraft gunner a higher precision and an almost complete release from the limitations of site and obscuration by 'ground-clutter' which had crippled his tactical freedom in using metric-wave GL sets. They were applied by our American collaborators in ground installations of considerable elegance and high adaptability which made great contributions to the defeat of the flying bomb and to the close air support of ground forces in the liberation of Europe.

Bombing by Radar

Perhaps the most picturesque, and certainly one of the most valuable, of the centimetric radar devices is the 'H2S' airborne aid to the bombing of invisible targets. The 'P.P.I.' picture in which seas, lakes and waterways remain black because they give substantially specular reflexion of the scanning pencil away from the aircraft projecting it; in which coastlines, with their cliffs, bays and inlets, show up clearly as outline map features because they scatter radiation back towards its source; in which the inland landscape is of a nondescript intermediate tone; and in which the 'works of man'—camps, hangars, and above all towns and cities—stand out brightly, the towns reasonably clearly defined in outline at tens of miles and in some detail at ten miles and under; this fascinates everyone at first acquaintance and never ceases to impress even the hardened boffin.

It has no competitor in this grip on the imagination, save perhaps the other blind-bombing device, of higher precision but limited coverage, called 'Oboe'. That two controllers sitting in vans on English soil should each know with an accuracy of a few yards each way—certainly within fifty yards—the position of an aircraft over Essen is a surprising thing, no more and no less surprising when one reflects that they know it much better than do the occupants of the craft. Yet in principle it is ridiculously simple; one ground station, *A*, knows the deviations of the craft from a circular track of constant distance from *A*; the other, *B*, knows when the craft flying a circle about *A* is at any desired distance, including zero distance, from the intersection of that circle with another of known radius about *B*. And this point of intersection was selected, in the relative comfort of the English ground stations, to be the bomb-release point, arrived at by applying up-to-the-last-moment corrections for the local wind conditions over the German target. *A* and *B* are pulse-interrogator stations, the aircraft has a responder of constant and accurately known delay-time, and meticulous calibration and adjustment assure an accuracy in radar range finding of one in ten thousand or so at some two hundred miles.

Radar in Peace

Radar in war fell into three convenient categories, each of which has come to stay in the peace.

Primary radar is that form of radar which "does not require the co-operation of the object to be located". It is useful against icebergs and enemies generally; it is an extravagance when used against friends.

Secondary radar requires that small measure of co-operation which is involved in the fitting and switching on of an otherwise automatic responder. The responder sends back, when interrogated by radar pulses, reply pulses on a different wave-length —so that 'ground clutter' disappears from secondary radar—coded with information about the 'personal identity' of the craft carrying the responder, and about its flying height if it is an aircraft.

Radar navigation does not depend essentially on the return of an echo, amplified or unaltered, from the craft to be located. It may in some special cases like 'Oboe' find that convenient; in some other and more frequency cases like 'G-H' and 'Babs' (Blind Approach Beacon System) and 'Rebecca-Eureka' utilize coded responses sent back by a ground responder-beacon in reply to pulses from an airborne or shipborne interrogator. And in 'Gee' and 'Loran' and related systems it will depend on a measurement in the craft of the time-difference of arrival of primary pulses from synchronized ground stations in accurately surveyed positions.

In a well-ordered world—which includes, but goes beyond, a world at peace—primary radar would have no place in aviation save as an airborne means of avoiding dangerous high ground and dangerous clouds and as a 'last resort' ground system for locating aircraft whose responders had failed, as they may on occasion do even in a well-ordered world. In the shipping world it would have a corresponding role, save that all ground is then dangerous high ground and the iceberg is the equivalent of dangerous cloud. In land transport primary radar should have no place at all; but primary radar on the ground will help the meteorologist in his still difficult task of forecasting. The world has still some way to go before even an optimist will regard it as well-ordered, and so ships will sail and aircraft fly with primary radar performing other duties which will ultimately be better confided to secondary radar.

The aim of the radar aids to civil aviation which were discussed at the recent Third Commonwealth and Empire Conference on Radio for Civil Aviation (C.E.R.C.A.) in London is to give from a generous provision of ground installations and the minimum of equipment in the aircraft, sufficient information (without the intervention of communications from ground controllers) for the pilot to know at every moment where he is, how to fly to his destination by the shortest or safest route, and how to land safely whatever the visibility. These provisions will be supplemented by radar aids which will keep the air traffic controller fully informed of the traffic pattern around his airport and on his designated routes. It will not be done cheaply, but independence of the weather has never been cheaply bought.

The simpler problems of marine transport find simpler radar solutions, and the sea and air transport without which our great Commonwealth and Empire cannot hold together in its service to civilization need radar services with an urgency second only to that which produced radar services in war.

Of railroad radar no one will at this date speak with equal confidence. But it is surely reasonable to believe that the simple elements of secondary radar in cab, cabin and caboose will at last banish the primitive detonator from this fog-girt isle! Romance cannot wholly dispense with radar in its noble task of bringing up the eight-fifteen—especially in the not infrequent conditions in which it is not romance alone that is 'all unseen'.

SCIENCE IN THE U.S.S.R.*

ASTRONOMY AND TERRESTRIAL MAGNETISM

By Sir HAROLD SPENCER JONES, F.R.S.

Astronomer Royal

RUSSIA has played an important part in the development of astronomy since the foundation of the Pulkova Observatory by Czar Nicholas in 1839. Under the direction of F. G. W. Strüve, this observatory was built regardless of expense. It has made notable contributions to fundamental astronomy, its instrumental equipment for such observations being more varied and complete than that of any other observatory. The Pulkova observations have always been characterized by their great accuracy. At the beginning of the present century, the work was expanded to include astrometry and astrophysics. Its great refractor, of 30-inches aperture and 45-feet focal length, was one of the finest in the world. In 1908 an astrophysical observatory was established at Simeis in the Crimea. There were, at the time I visited Russia in 1914, several other observatories, but for the most part their equipment was modest and their staffs were small. Since the Revolution a great expansion in astronomical work has occurred. Additional instrumental equipment has been installed, including the 40-inch reflector at Simeis: new observatories have been constructed in Abastumani (Georgia), Stalinabad (Tajikistan), Yerevan (Armenia), Pòltava (Ukraine) and Alma Ata (Kazakhstan), the last of these during the war years. Astronomical institutes have been established in Moscow and Leningrad, for computational and theoretical work in the fields both of astrophysics and of celestial mechanics. The total staffs have been increased about ten-fold.

In the pre-Revolution days, each observatory worked alone, and its resources were generally insufficient to enable large programmes of observation to be undertaken. In the Soviet years an Astronomical Council has been constituted by the Academy of Sciences which co-ordinates the work of the various observatories, including both those which come directly under the Academy and those which are attached to universities. Thus, it has been possible, by pooling of effort, to undertake fields of work which are beyond the scope of any single observatory and also to avoid unnecessary duplication. For example, observations of selected minor planets and of the positions of some 16,000 red giant stars have been undertaken at several observatories for the improvement of the fundamental system of star places. Special attention has been given to solar phenomena and their terrestrial relationships. The paths of totality of the total solar eclipses of 1927, 1936, 1941 and 1945 have crossed Soviet territory and extensive programmes of observation were planned. For the last three of these eclipses some fifteen to twenty expeditions were organized and were distributed along the line of totality—valuable results being obtained.

The time service has been extended, and its accuracy considerably improved. A Nautical Almanac is published to meet the needs of navigators and surveyors as well as astronomers. The computations for its production are made at the Astronomical Institution in Leningrad.

Soviet astronomers have made important contributions to the theory of the structure of comet tails and heads, to the problems of the variation of latitude, to the study of the atmospheres of stars (including the discovery of heavy isotopes of carbon), to the problems of novæ, and to cosmogony.

Astronomy in the U.S.S.R. has suffered a serious setback through the destruction of, or damage to, various observatories. The Pulkova Observatory was in the front line for two and a half years in the fighting around Leningrad and has been completely destroyed by German shelling and bombing, though some of the instruments were saved. Most of its valuable astronomical library, probably the most complete in the world, has been lost; some of its treasures, including the manuscripts of Kepler, were fortunately saved. Its destruction was no doubt inevitable in the circumstances. But it was otherwise in the case of the Simeis Observatory, for no fighting took place in its vicinity. The Germans removed the telescopes (which have since been found in Potsdam, but in a state unfit for use), most of the library and most of the astronomical negatives; they then deliberately set fire to and destroyed the Observatory. The Observatories at Odessa, Kiev, Nikolaiev, Kharkov and Poltava were all badly damaged. Many of the observational records have been removed or destroyed, so that some of the co-operative programmes of observation, on which much work had been done, will have to be commenced anew. Many of the astronomers and some of their instruments were evacuated far into the interior. Some of the Pulkova astronomers were moved from Leningrad by aeroplane during the siege. Throughout the War a considerable amount of research in astronomy was continued in spite of the difficulties of the conditions.

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* Continued from page 285.

The reconstruction of some of the damaged observatories has already been commenced. Plans have been prepared for the rebuilding of the Pulkova Observatory according to its original plan; the telescopes which were saved will be replaced in their original positions. But new additional instruments will be installed. Plans are under consideration for the establishment of a large astrophysical observatory in the Crimea, provided with powerful reflecting telescopes and with instruments of modern types; there may be also a subsidiary station somewhere in the southern hemisphere.

Mention may be made of the invention by Dr. Maksutov during the War of the new system of meniscus lens telescopes which, because only spherical surfaces are employed, are simple to manufacture. These telescopes are powerful and extremely compact. The largest meniscus telescope as yet constructed is of nine inches aperture; but telescopes of this type and of greater aperture are to be constructed for astronomical observation.

It is certain that the U.S.S.R. is destined to play a prominent part in the development of astronomy in the post-war years.

The Institute of Terrestrial Magnetism, established in Leningrad in 1940, embraces a wide field of work. It comprises sections for land magnetic surveys, sea magnetic surveys, magnetic observatories, magnetic cartography, ionospheric and cosmic ray observations, and theoretical investigations. Nineteen permanent magnetic observatories, including some high-latitude stations, were in operation when the War started. Six of these at Yanov, Stepanovka, Novgorod, Amvrossievka, Nizhnedevitsk and Pavlovsk were occupied by the Germans in 1941–42: same of the staffs were evacuated and some were made prisoners. When the Germans retreated they burned or blew up the observatory buildings in Pavlovsk, Novgorod and Nizhnedevitsk. Observational records and instruments were removed or destroyed. The magnetograms of the Second Polar Year stations have disappeared. Profs. Weinberg and Trubyatchinsky died of famine during the siege of Leningrad. Magnetic survey work has been continued during the War, and some expeditions were sent to the north of Siberia. Observations are made at regular intervals at a number of repeat stations for the determinations of secular changes. Magnetic anomalies associated with possibly useful mineral deposits have been studied. Solar, magnetic and ionospheric data are collected and summaries are published in ten-day cosmic bulletins.

The Institute is to be moved to a site near Moscow, where special buildings are to be erected, and the magnetic observatories destroyed by the Germans are to be re-established. Theoretical investigations in terrestrial magnetism and allied subjects are also carried out at the Institute for Theoretical Physics in Moscow, where Prof. Frenkel has recently developed new theories of atmospheric electricity and of the earth's magnetism. Among other work undertaken at this Institute are theoretical investigations of the scattering of light in the earth's atmosphere and of atmospheric transparency, and the study of the light of the night sky.

THEORETICAL PHYSICS

By Prof. M. Born, F.R.S.

University of Edinburgh

In the original group of British delegates to the Moscow conference, theoretical physics was well represented (Darwin, Dirac, Mott and myself); but I was the only one allowed by the Government to proceed. The following account is therefore based only on the observations of one pair of eyes and ears, which had to absorb a multitude of impressions vastly more interesting and important than even the most fascinating scientific things: a new and strange type of civilization in its various activities, social, economic, military, scientific, artistic, etc.

Theoretical physics can scarcely be separated from physics in general, on which Andrade has reported in a previous number of *Nature* (August 25, p. 223). I shall add a few remarks to his excellent account, but speak mainly about the more abstract branches of my subject. As the Soviet State is based on a definite philosophical system, the question arises whether this fact has any influence on the development of fundamental ideas in physics. I have found scarcely any traces of such an influence, and certainly no restrictions of research. The Russian physicist interprets the facts of observation in the same spirit of intellectual freedom as his Western colleague, and indulges in any speculation on cosmology, relativity or quantum theory without being censored. Nor does the question of the practical applicability play a great part, as many of the reports on other subjects have already stressed. Fundamental research is acknowledged as the basis for a sound growth of science, and a theoretical physicist is no more expected to produce results of economical importance than the roots of an apple tree to bear fruit; but if the roots are allowed to spread freely the branches carry a good crop.

The theory of relativity has a powerful representative in V. A. Fock (Moscow). A most important paper of his which appeared just before the War (February 1939) is little known in Britain. It contains the solution of the fundamental problem, also treated by Einstein (and collaborators), whether the field equations of gravitation are sufficient to determine the orbits of planets, or whether separate equations of motions are necessary. Fock's answer is that no such assumptions need to be made; he obtains Newton's laws as a first approximation for small bodies separated by large distances and develops the relativistic correction terms. I had a short discussion with Fock on Mises' foundation of the theory of probability and found him very sceptical: to define probability as the limit of relative frequencies in an actual series of trials seems to be a vicious circle, for there is no certainty of the existence of such a limit, but only a probability. I think Fock is right. He is also a great expert in quantum mechanics. I found him and the other Russian physicists perfectly acquainted with the newest developments, in particular of the theory of quantized fields and its application to radiation and mesons. J. Tamm (Moscow) and J. Frenkel (Leningrad) are working on these problems; their attitude to the well-known difficulties and perplexities is not much different from my own. To mention only one point, they are not satisfied by Eddington's ingenious theory of ultimate particles. Among the many other questions we discussed, I wish to direct attention to Frenkel's dynamic theory of atmospheric electricity, which has just appeared and seems to me very promising. As Andrade has already pointed out, Frenkel is attached to Joffe's laboratory in Leningrad and takes an active part in the interpretation of the experiments on semi-conductors and other things.

In an account of theoretical physics, the theoretical part of physico-chemistry cannot be excluded. In Moscow it is brilliantly represented by Frumkin, in whose laboratory well-planned work is done on the chemistry and physics of surface layers.

Russian physics suffered a great loss last year by the death of Mandelstam who, together with Landsberg, discovered almost simultaneously with Raman and independently the phenomenon since called the Raman effect. Mandelstam's optical school is continued under Landsberg's leadership. Another member of it is E. Gross, who discovered the splitting of spectral lines in a beam of light which is scattered by a liquid or a crystal, an effect due to the Doppler effect produced by the reflexion of the light waves on sound waves.

Russian physicists were very keen to learn something about work done in Britain, and I had to give several lectures. One of these was in the Lebedev Institute of Physics, the director of which, S. Vavilov, has just been elected president of the Academy of Sciences of the U.S.S.R. This visit gave me the opportunity of a glimpse of the celebrated laboratory and a discussion with its workers on diverse problems.

The limits of this article do not allow me to give an account of new discoveries in crystal physics and their explanation. I must, however, add a few remarks to Andrade's description of Kapitza's Institute for Physical Problems and the work done there. For this Institute contains a separate group of theoretical physicists under Landau's leadership who have made essential contributions to the low-temperature work going on. Kapitza himself is an expert in thermo-dynamics, which he applies as an engineer to the technical problems of the liquefaction of air, and as a physicist to research on liquid helium. It is most remarkable and characteristic of Russian science how applied and pure physics, experiment and theory, are here combined. Andrade has mentioned Landau's theory of superfluidity which was published in 1941, but has been improved by him and his collaborators. It will cause the theorists some 'headaches'; for though it is most successful in predicting experimental results, for example, the existence of two different velocities of sound (the normal one of about 220 m./sec. and a slow one of about 20 m./sec.), it also contains many obscurities. The first part deals with the quantization of the hydrodynamical equations for ideal liquids. The second part describes helium II as a mixture of two phases, or interpenetrating liquids, one having viscosity, the other not. This new and surprising idea is clear in itself but scarcely connected with the first part. The link is a consideration about the quantization of vortex motion, which leads to the conclusion that the range of energy states (of the whole liquid) consists of two parts separated by a gap $\triangle$, one part representing the irrotational, the other the vortex motion. The existence of this finite energy $\triangle$ prohibits, for slow motions of the liquid, the excitation of quanta, therefore the transfer of momentum from the walls, and this means lack of viscosity. Landau gives an expression for $\triangle$ in terms of density ρ, mass of the atom m and Quantum constant $\hbar$; the formula as published is wrong, but the idea is right. One has simply to remember the well-known expression for the so-called degeneration parameter from the Einstein-Bose or Fermi-Dirac statistics, $A = n\hbar^3/(m\triangle)^{3/2}$ where $n = \rho/m$ is the number of particles per unit volume. If $\triangle$ is expressed in terms of a critical temperature T_0, $\triangle = kT_0$, then for $T_0 = 1°$ K. the dimensionless quantity A is very small for a gas, but of the order unity for a liquid*. Hence quantum effects can be expected for every liquid at temperatures of the order 1° K., but are only observable in helium as all other substances become solid at such low temperatures. Landau shows how the actual value of $\triangle$ can be determined from measurements of specific heat and finds that it is 8–9° K. This value is then used for further calculations, for example, of the two velocities of sound.

There are many other interesting investigations which I should like to discuss; but I have first to digest the reprints which were given to me in considerable numbers.

I cannot close this report without expressing my thanks to the Russian colleagues for the kind reception and hospitality we found in their midst.

(*To be continued.*)

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* Landau's formula should read

$$\hbar^2 \rho^{2/3} m^{-5/3} = \hbar^2 n^{2/3} m^{-3/3} = A^{2/3} \triangle.$$

OBITUARIES

Colonel C. H. D. Ryder, C.B., C.I.E.

COLONEL CHARLES HENRY DUDLEY RYDER died on July 13 at Bognor Regis at the age of seventy-seven. He was the seventh son of Colonel Spencer Dudley Ryder and was educated at Cheltenham College and the R.M.A. Woolwich, whence he received a commission in the Royal Engineers. After the usual courses of instruction at Chatham, he proceeded to India and was posted in due course to the Survey of India, in which the whole of his subsequent career was spent.

Much of Ryder's earlier work up to the first World War was carried out on active service or deputation in China, Tibet, Persia and Turkey. Later he was placed in charge of frontier surveys in India, and after taking command of the Survey Service in Mesopotamia during 1917–18, he succeeded Sir Sidney Burrard in the latter year as surveyor general of India, retiring from that post in 1924.

Ryder's greatest contributions to geography were in the field of survey and exploration in China and Tibet. In 1895, not long after joining the Survey of India, he served on the Mekong Boundary Commission, demarcating the Burma-Indo-China frontier. During 1898–1900, with Major Davies, he surveyed most of the routes in the Yunnan Province of China and in parts of Szechwan. Their journeys ended in a voyage down the Yangtse River to Shanghai, and their work forms the basis of present-day maps of these regions. In 1901–2 he was again in China as a survey officer with the Chinese Expeditionary Force. After a brief interval in India, he joined the Tibet Frontier Commission in 1903 and Sir Francis Younghusband's mission to Lhasa (1904). Taking advantage of the newly imposed treaty terms and of the presence of British troops, Ryder was given a free hand to carry out exploration in southern Tibet, and accompanied by Captain Rawling and a very small party he travelled westwards up the Tsangpo valley, exploring and surveying many thousands of square miles of, for the most part, unknown country. They fixed the sources of the Tsangpo, Sutlej and Indus, surveyed Lakes Manasarowar and Rakas Tal, and the region of the holy mountain of Kailas. Their work was controlled by the positions of the Himalayan snow peaks to the south which had been fixed many years previously from the plains of India. A great number of additional peaks were fixed, and the claim that Mount Everest was the highest mountain, in any event in regions hitherto explored, remained unassailed. The expedition reached Simla by way of the Shipki Pass in January 1905; its results form by far the greatest single addition to knowledge of the topography of the Tibetan plateau.

In 1913–14 Ryder served as chief survey officer on the Turco-Persian Boundary Commission, and as deputy commissioner during the absence of Mr. Wratislaw in the later months. The demarcation of this long frontier was complicated by a number of intricate negotiations. For his explorations in China and Tibet Ryder received the Patron's Gold Medal of the Royal Geographical Society, the Silver Medal of the Royal Scottish Geographical Society, and the Gold Medal of the French Geographical Society, and he was awarded the C.I.E. for his work on the Turco-Persian boundary.

C. G. LEWIS.

Dr. Catherine Alice Raisin

DR. CATHERINE ALICE RAISIN, a pioneer who blazed many new trails, died at Cheltenham on July 13 at the age of ninety. Her early education was received at the North London Collegiate School, of which she always spoke with gratitude as being one of the earliest schools to start providing more serious education for girls. Miss Raisin continued as a teacher at her old school until 1875, when the opening of certain classes to women students was advertised by University College, London. Among these was a course in geology by Prof. Morris. Miss Raisin attended this class, and so became the first woman to take geology in the University. In the following year she joined Prof. Morris' classes in mineralogy, only to discover after the course was completed that it had not been officially open to women.

In 1878 the degrees of the University of London were thrown open to women, and Miss Raisin at once began to prepare for her B.Sc. After passing the Intermediate Science examination in 1879, she selected geology, botany and zoology as her three subjects. She attended Prof. Bonney's classes in geology at University College during 1880–82, and Prof. Bower's classes in botany. Attracted by Prof. Huxley's work in zoology, Miss Raisin obtained special permission from him, in 1883, to attend his classes at the Royal School of Mines. After graduating B.Sc. with honours in geology in 1884, Miss Raisin continued at University College as a research worker, and at the same time as a voluntary assistant to Prof. Bonney, who was then very much overburdened with work. She received her D.Sc. in 1898, and in 1902 was elected a fellow of University College.

During the years when she was preparing for her degree, Miss Raisin achieved one of her earliest ambitions by founding and organizing a discussion club for women—the Somerville Club—which foreshadowed the youth movement of to-day. The work involved must have seriously interrupted her studies, for when the Club opened in 1880 she had already enrolled a thousand members. Under her inspiring leadership, first as honorary secretary and later as chairman, the Club flourished actively for several years. Meanwhile, other educational amenities for women were being developed in London, and in 1887, having served its initial purpose, the Club was wound up.

During 1886–90, Dr. Raisin was demonstrator in botany at Bedford College for Women. In 1890 she succeeded Prof. Grenville A. J. Cole as head of the Geology Department at Bedford College, a position which she held, together with the headship of the Geography Department, until she retired in 1920. Her outstanding teaching and administrative ability are further evidenced by the facts that she was head of the Botany Department during 1891–1908 and was also vice-principal of the College during 1898–1901. From these additional duties she eventually resigned in order to give more time to the claims of geology.

The originality of Dr. Raisin's teaching was in no respect better shown than in her celebrated lectures on petrographic provinces, which became the more fascinating since they were illustrated by practical work on rock specimens of her own collecting from many of the classic areas of Europe and North America. She was a first-class petrographer, with a firm grasp of the optical properties of minerals—then quite exceptional. Rightly unbound by fashion in petrogenetic thought, as time has shown, she stood almost alone in Britain in stressing the work of Lacroix, Termier and Sederholm on granitization, even at the time when crystal differentiation was beginning to hold the field as a major petrogenetic process.

Dr. Raisin's published work includes a long series of petrological and stratigraphical studies, dealing with rocks from the British Isles, Europe, North Africa and India. Her first paper, concerned with the metamorphic rocks of South Devon, was published in 1887, and is notable as representing an early attempt to recognize and map metamorphic facies. Dr. Raisin is, however, best known for her detailed investigation of serpentines.

In 1893 Dr. Raisin was awarded the Lyell Fund by the Geological Society of London, being the first woman to receive any such recognition from this Society. At that time women were not even allowed to attend meetings of the Society, and Prof. Bonney received the award on her behalf. When in 1919 women were admitted as candidates for fellowship of the Geological Society, Dr. Raisin was elected a fellow.

Dr. Raisin will be remembered by her students, not only as a stimulating and enthusiastic teacher, who worked ungrudgingly to promote their interests, but also as a generous, brave and sympathetic woman whom they loved.

DORIS L. REYNOLDS.

Prof. H. E. Annett, M.B.E.

THE death occurred on April 11, 1945, of Henry Edward Annett, at the age of seventy-four years. Dr. Annett's scientific career was varied and his interests ranged over several fields—tropical diseases, bacteriology and pathology among them.

As an undergraduate at the University of Liverpool, Dr. Annett studied physics under Sir Oliver Lodge, but later, in spite of Lodge's persuasions to continue his work as a physicist, he decided to study medicine. After graduating in medicine, he was elected to an 1851 Exhibition and carried out research on tuberculosis under Robert Koch in Berlin. He was a member of the first malaria expedition sent to West Africa by the Liverpool School of Tropical Medicine in 1891, and during the following year he himself directed a similar expedition. In 1905 he led the Animal Disease Expedition to Uruguay, and in 1906 the Colonial Office Expedition to the West Indies. He was later appointed to the chair of comparative pathology at the University of Liverpool, an appointment which he held until 1911.

Dr. Annett then devoted himself to research in bacteriology, a field in which he became widely known, and for some years was director of the Bacteriological Research Department of Messrs. Evans, Lescher and Webb, in Runcorn. While there, he discovered the 'Liverpool' virus used for killing rats and mice. During the War of 1914–18 he was asked to study the effect on child health of milk preservation by the use of formaldehyde and the conclusions he reached, which were embodied in a Select Committee report, led to a legal ban on formol preservation. For this service he was awarded the M.B.E. The later years of his life were devoted exclusively to researches on cancer and allied problems, and he was occupied with this work up to the time of his death.

Dr. Annett's health had been declining for some years, and his unfailing kindness and encouragement, graced with a rare sense of humour, will be missed by those younger research workers who had the good fortune to come into contact with him.

SARAH BARNES.

Dr. W. Knoche

DR. WALTER KNOCHE, a well-known investigator on climatology, atmospheric electricity, geography and ethnology, died on July 3 at Buenos Aires. He was climatologist to the Servicio Meteorológico Nacional of the Argentine Republic, as a successor to the late Robert Mossman.

Knoche was born in Berlin on March 7, 1881, his mother being a sister of Paul Ehrlich, one of the pioneers of modern chemical therapeutics. Through his uncle's example, Knoche received a powerful stimulus towards medical and physiological problems, and indeed a great number of his climatological investigations were devoted to the relations between climate and man, animals and plants. He studied at Geneva and Berlin, as a pupil of von Richthofen in geography and von Bezold in meteorology. After a short scientific expedition to Bolivia, where he made an extensive series of valuable meteorological observations at the height of 5,200 metres, he became in 1910 the chief of the Meteorological and Geophysical Institute of Chile, a post which he held until 1916. A great number of his early publications deal with atmospheric electricity, based on his own observations on land and sea and on mountains throughout the vast area between Teneriffe and Easter Island, and especially South America. His expedition, in 1911, to Easter Island led him to begin a comprehensive study of its different geographical and anthropological problems, which he discussed in a valuable monograph.

During recent years, Knoche's chief interest was concentrated on phytoclimatology, the formation of deserts, colonization, classification of climates and general bioclimatology, and it is fair to consider him one of the pioneers of this new branch of science. He was the author, together with the late Vladimir Borzakov, of a book on the climate of Argentina, now in the press.

A more detailed review of Knoche's many publications, considerably more than two hundred in number and dealing with an unusually wide range of subjects, will be given in the Argentine journal *Ciencia e Investigación*.

OTTO SCHNEIDER.

Prof. F. von Wettstein

THERE will be general regret at the information, received from private sources, that Prof. Fritz von Wettstein has died recently in Germany.

Son of Prof. R. V. Wettstein, of the University of Vienna, he achieved as great an eminence as his father in the advancement of botanical and genetical science. Under Erwin Baur at the Kaiser Wilhelm Institut, Berlin-Dahlem, he undertook research work on hybrids and polyploids in mosses, and was one of the first to show the relationships and characteristics of polyploid forms. In 1926 he was appointed professor of botany in the University of Gottingen, where his energies built up the Botanical Garden to be a centre for the breeding of cacti and for investigations on various cryptogams. In 1933 he was appointed to one of the premier botanical chairs of Germany, that of the University of Munich; and later, on the death of Erwin Baur, he was called to take charge, I believe unwillingly, of the German plant breeding and botanical programmes that were under way at the Kaiser Wilhelm Institut at Berlin-Dahlem.

Of a quiet unassuming character, earnest and extremely enthusiastic on any subject relating to botanical genetics, his death, at a comparatively early age (about fifty-eight), is a great loss to science. What I remember most distinctly about Wettstein was his extreme friendliness and overwhelming hospitality to all with whom he came in contact; and despite a lack of English, his ability to overcome language difficulties when talking about his well-loved *Funaria hygrometrica* and *Solanum* chimæras.

F. W. SANSOME.

NEWS and VIEWS

Dr. W. F. P. McLintock: Director of the Geological Survey of Great Britain

THE appointment of Dr. W. F. P. McLintock to succeed Sir Edward Bailey as director of H.M. Geological Survey and Museum is especially fitting at this stage in the long history of that institution. Dr. McLintock's keen analytical mind, his long administrative experience and his gifts for effective planning and exposition, are now brought most opportunely to the re-organization of the Survey's peace-time activities. After graduating at the University of Edinburgh, Dr. McLintock joined the Geological Survey in 1907 as assistant curator in the Museum of Practical Geology. In 1911 he left the Survey to take charge of the Geological Department of the Royal Scottish Museum, where he was responsible for the exhibits of the Geological Survey in Scotland. In 1921 he rejoined the Survey as curator and became deputy director in 1937.

Dr. McLintock's research has been concerned with the crystallography, mineralogy and paragenesis of the rare minerals datolite and petalite from Cornwall, with topaz and beryl from Lundy Island, and with zeolites from the Tertiary lavas of Mull. Of especial interest is his account of the metamorphism of sedimentary rocks by the combustion of hydrocarbons in south-west Persia. He described the Strathmore meteorite. His most important contributions, however, have been concerned with geophysical methods of geological survey. In 1926 he proceeded to Persia to study, under the auspices of the Anglo-Persian Oil Company, field methods of geophysical survey; and later, in collaboration with Dr. J. Phemister, he executed a number of surveys—gravimetric and magnetic—over geological structures such as dykes, faults, unconformities and buried channels, in order to obtain data for the critical appreciation of the value of geophysical methods in geological surveying. Dr. McLintock undertook the replanning of the Museum of Practical Geology on its transference from Jermyn Street to the South Kensington site, and was responsible for the scheme of exhibition in the new Museum. The success of this Museum and its recognition as the foremost geological museum of the world are mainly due to his untiring and enlightened directive efforts. Geologists look forward with confidence to the speedy recovery of its former glories.

Mr. A. A. Kift

MR. A. A. KIFT, who has served for forty-three years with Marconi's Wireless Telegraph Company, Ltd. and during the last twenty years has been successively sales manager, assistant engineer-in-chief and contracts manager, retired from the Company's service at the end of August. Mr. Kift is one of the best known Marconi officials and is one of those engineers who joined soon after the Company's formation and may be said to be responsible for laying its foundations. Like many of those early wireless pioneers, Mr. Kift received his training as an electrical engineer at Finsbury Technical College. After a further specialized course at the Marconi Training College at Frinton, he was appointed to the erecting staff and was engaged in fitting some of the first half-dozen White Star liners which were equipped with wireless in and about the year 1902 at a time when a range of 50–100 miles with a coherer receiver was regarded as very satisfactory communication. After that, Mr. Kift's work for the Company, afloat and ashore, ranged from the Labrador coast to Varna on the Black Sea, with the erection of stations round the English coast interspersed with his foreign travel.

Institute of Fuel: Deputy Secretary

MR. REYNOLDS-DAVIES has been appointed deputy secretary of the Institute of Fuel. Mr. Reynolds-Davies received his technical education at University College, Cardiff, and the South Wales School of Mines. He has had a wide experience as a chemical engineer and fuel technologist for several years. His industrial experience was obtained first of all as chemist on the Coke Oven Plant of the Cambrian Combine, now merged with the Powell Duffryn Associated Collieries, Limited. He was later engaged as assistant with the late Dr. W. R. Ormandy on Power Alcohol and Petroleum Products. This work was followed by nine years as one of the chemical plant managers with the British Industrial Solvents, Ltd. For the past three years, he has held the position of manager of the Development Department of the Royal Ordnance Factory at Bridgend.

Carnegie United Kingdom Trust

THE thirty-first annual report of the Carnegie United Kingdom Trust, covering the year 1944, shows that the total expenditure on grants amounted to rather more than £71,000, the highest annual figure reached during the War. This includes £10,000 in aid of a post-war experiment to be undertaken in Shropshire, where a community house is to be established to serve partly as a residential college for short-term courses of adult education, but also as a focal point for cultural activities within the county. A special grant of £3,000 has also been made to Toynbee Hall to enable it to extinguish a deficit, largely on building account, the continued existence of which is due mainly to war conditions. A grant of £2,000 has been promised to the Council for the Promotion of Field Studies towards the initial cost of adapting and equipping a pioneer field centre at Flatford Mill, Suffolk (see *Nature*, **155**, 744; 1945). The largest block of expenditure during the year was on youth services, which took nearly £22,000 as against £23,000 in 1943. Grants to the headquarters of national youth organizations decreased by about £3,000, but club equipment grants increased by about £6,000 to £15,000. The Trust intends to continue for a further period its provision of grants in aid of the equipment of hostels and camps provided by national and voluntary youth organizations, under detailed conditions which have been communicated to the organizations likely to be concerned. Discussions with the National Association of Boys' Clubs have been proceeding during the year, and the Trust has agreed in principle to provide the capital sum required for the acquisition and the first stage of adaptation of a country house in which the Association proposes to set up a residential institution for standardized training. A report has also been requested by the Trust on periodical literature for juveniles, with the view of considering improvements in this field, and the report is to be prepared on its behalf and at its expense by the Research Department of the National Council of Social Service. The endowment income of the Trust amounted in 1944 to £122,801, and of this £80,366 was expended on grants and administration.

A New Approach to School Mathematics

WITH the re-classification of secondary schools in Great Britain under the new Education Act, there is an urgent need for the complete overhaul of the curricula of these schools. This is especially true in the case of mathematics, evidence of which is to be found in the recent reports on school certificate mathematics (Conf. Exam. Bodies and Teachers' Associations, 1944); on the teaching of mathematics to physicists (Mathematical Association and the Institute of Physics, 1944); and on sixth form examinations in mathematics (Cambridge Joint Advisory Committee for Mathematics, 1945). In suggesting an alternative syllabus to those in operation at present, the first-named report makes the significant remark: "The whole syllabus is inspired by a desire to bring mathematics more closely in relation with the life and experience of the pupil". Herein lies the kernel of the question, and it is symptomatic of the dissatisfaction felt at the existing courses, which are largely dominated by the syllabuses of the examining authorities. With approximately four-fifths of the pupils now leaving secondary schools at school certificate level, the huge gap between examination mathematics and the essential needs of after-school life calls for some fundamental change. The need for a fresh approach to the mathematical curriculum has been ably dealt with by Mr. C. T. Lear Caton in his presidential address to the Midland Branch of the Mathematical Association (*Math. Gaz.*, July 1945), and his advocacy "to replan the mathematics courses in all types of schools to fit in with the new educational structure and to contribute more effectively to the needs of the post-war world" sums up very concisely the case for immediate reform.

In Britain, the logical process of making necessary basic changes in established systems is traditionally slow; but the second great world war has shattered many of those systems so that progressive action is urgently imperative. The late Sir J. J. Thomson ("Recollections and Reflections") tells of a student who only learned to respect mathematics because of its application to billiards! This interesting case typifies the need for emphasizing the outward aspect of the subject and provides the clue to the guiding principle for reform. The problem, however, is far from easy, for it will obviously be dangerous to swing over to the other extreme by rejecting all that has no relation to what Sir Percy Nunn calls "the world of outer realities lying in time and space" ("The Teaching of Algebra"). On the other hand, there is little reason in placing a canopy of alleged difficulty round such a topic as infinite series when they hold the very key to the method of calculating tables, about which most students are so inquisitive. Indeed, the whole trend of any movement towards an intelligent reformation must be directed with much understanding, mature knowledge and an absolutely unbiased outlook.

Quality Control in Business

A SERIES of six articles by Mr. William B. Rice on quality control in business production and administration have been separately reprinted from *Western Industry*, the *Journal of the American Statistical Association* and the *Accounting Review*, and provides a useful introductory account for anyone interested in the application of statistical methods in business. Mr. Rice, who is the director of the Department of Statistics and Reports of the Plomb Tool Company of Los Angeles, writes with first-hand experience of the methods he describes and drives home his points with a wealth of practical illustration. The first four of his articles deal with the control of quality of a manufactured product on fairly familiar lines—an expository presentation which should do much to arouse interest among manufacturers. In the remaining two he extends the technique to business administration and office accounting, showing, for example, how excessive overtime costs in a department of an engineering plant were tracked down and eliminated, and how administrative charges in a business were brought under control. This is quite a recent development of the subject, and provides an interesting illustration of the growth of scientific methods in the most ordinary commercial operations.

The statistical theory required in quality control is comparatively elementary; but the most striking successes have been obtained by introducing it into factory production processes. In some cases the methods amount to little more than a systematic sampling of the product and a graphical presentation of the results; and yet they appear to lead to the tracing of sources of trouble in the manufacturing process with an efficiency which astonishes nobody more than the men who have had years of experience on the job and are naturally inclined to think that they have nothing more to learn about it.

Nutritive Values of War-time Foods

DIETARY surveys of the population which are being carried out by the Ministries of Food and Health have created a demand for food-tables giving, for raw foods, values for proteins, fats and carbohydrates and for the relatively small number of minerals and vitamins most likely to be deficient in human diet. Values for the composition of many foodstuffs consumed in war-time were not available in existing tables, and the differences between the values for war-time and peace-time foods are often very great. The Medical Research Council War Memorandum No. 14 now sets out "Nutritive Values of Wartime Foods" (Tables compiled for the Accessory Food Factors Committee. London: H.M. Stationery Office). Numerous analytical data, published and unpublished, have been considered in selecting the representative values in these tables. Many individuals have been consulted and have provided valuable data and advice. The values, including those for waste, are based for the most part on the results of direct analyses carried out during recent years in Britain. Such values were not always available, particularly for the vitamins, and it was necessary to make a selection from the values in the literature, distinguishing carefully those foods the composition of which had not been affected by the War. The losses during cooking are variable, affecting vitamin C severely, vitamin B_1 to a less extent and vitamin A probably still less. For processed foods, an allowance for loss of vitamins by destruction during cooking has been made in the tables.

Control of Weeds by Spraying

Loss in yield of cereal crops from competition with annual weeds is more serious than is generally realized, and gains of more than 50 per cent can often be expected as a result of correct spraying with a selective weed killer. Advisory Leaflet No. 315, Weed Control in Cereals, issued by the Ministry of Agriculture,

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

X-Ray Analysis with the Aid of the 'Fly's Eye'

IN a note in *Nature*[1], an example was given of the use of the 'fly's eye' for X-ray analysis. The reflexions of X-rays by planes around a crystal zone correspond in intensity to the optical spectra produced by a cross-grating, the pattern of which is that of the crystal structure projected on a plane perpendicular to the zone. The 'fly's eye' enables such cross-gratings to be made. The spectra they produce can be compared with the observed X-ray reflexions, thus avoiding the labour of calculation, at any rate in the first stages of the usual trial-and-error method of seeking the solution.

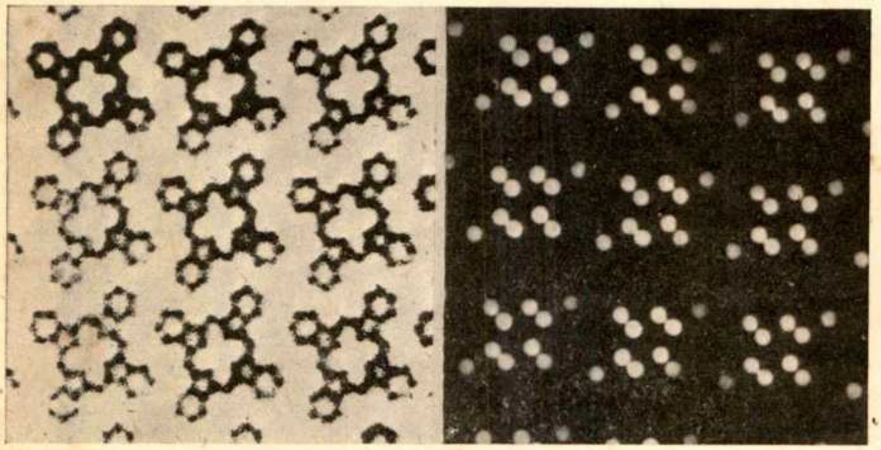
The original type of 'fly's eye' was a multiple pinhole camera, the holes being in a square array, forty to the centimetre. Each hole produces an image of a single illuminated object representing the unit of structure. An example of a cross-grating made in this way by Bunn is shown in Fig. 1*a*. It represents phthalocyanine and gave a good correspondence with observation (see *Nature*, *loc. cit.*). It has the disadvantages, however, that the images are diffuse because of the pinhole method and the grain of the photographic plate, and they are unequal in intensity because the minute pinholes are liable to be blocked by specks of dust.

The new type of 'fly's eye' described here gives much better cross-gratings. The pinholes are replaced by small lenses embossed on the surface of a 'Perspex' sheet. These are made by pressing a steel ball at regular intervals on a soft copper block, and casting or pressing 'Perspex' on the block. The actual array used for Fig. 1*b* consisted of lenses 0·5 cm. in focal length, 0·06 cm. in diameter and 0·13 cm. apart. A paper mask punched with corresponding holes cut out all light except that falling on the lenses.

The array of lenses, covering a circular area of 2·5 cm. diameter, with a photographic plate in their focal plane, is exposed to an illuminated ground-glass viewing screen on which black disks are laid representing the atoms in a single unit of pattern. They appear as transparent holes in Fig. 1*b*, which is an enlargement of the negative used as the cross-grating. The greater sharpness and uniformity of the pattern in Fig. 1*b* as compared with Fig. 1*a* is evident. The structure is that of durene[2] projected on (010), and referred to equal axes at right angles.

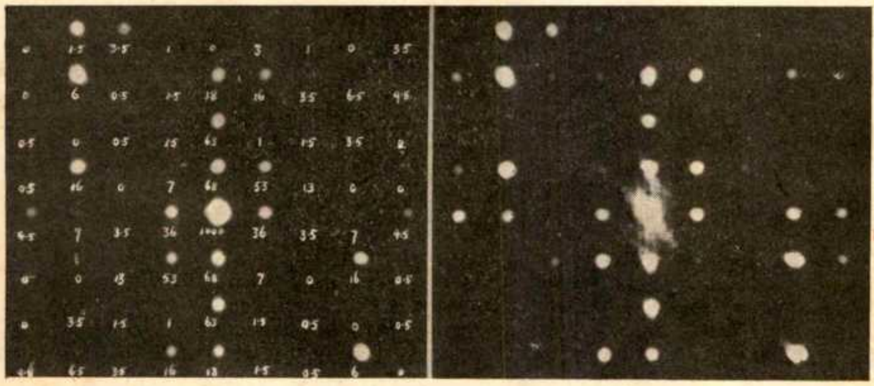
The cross-grating is mounted between optical flats with cedarwood oil in the interspaces, to reduce optical imperfections of the photographic plate. It is placed before a lens 1 metre in focal length, and the spectra photographed on a plate at the focus. It is convenient to use an eyepiece for viewing them. Fig. 2*a* shows the spectra so produced, the numbers representing the X-ray intensities recorded by Robertson. If allowance is made for the more rapid falling off of X-ray intensities with angle, due to the carbon scattering factor, it will be seen that the correspondence is good. Fig. 2*b* shows the poorer result when the optical flats and cedarwood oil were not used.

The new method has several advantages over the former one. The cross-grating is on a larger scale, hence the grain of the plate is not troublesome. The sharpness of the images should make it possible to represent the atoms as concentric rings so as to simulate the scattering curve of atoms. A series of gratings can quickly be made with different arrangements of the disks on the viewing screen, and it is therefore a rapid trial-and-error method in seeking a first approximation to the structure.



(*a*) (*b*)

Fig. 1.



(*a*) (*b*)

Fig. 2.

gives much useful information on the subject. Up to the present, sulphuric acid has proved to be the most effective chemical for the purpose, as it kills a wide range of weeds and is quick acting even in dull weather. Its highly corrosive properties, however, make it difficult to handle; so copper chloride and dinitro-ortho-cresol (D.N.O.C.) are suggested as alternatives. Directions for the use of all three substances are given, and comparison made between the concentrations of spray required in each case for the eradication of a number of common weeds. As regards time of spraying, rather more latitude is possible with copper chloride and dinitro-ortho-cresol than with sulphuric acid, which kills weeds only in the seedling stage, but usually the acid has a slight advantage if the weather is cold and dull. Full instructions are given in the use of these spray materials, and any precautions necessary for the protection of the operator or care of equipment clearly mentioned.

West of Scotland Field Studies Council

In 1944 members of the Glasgow and Andersonian Natural History and Microscopical Society, including Dr. Inglis Cameron, carried out preliminary work which resulted in the inauguration in April 1945 of the West of Scotland Field Studies Council. On the Council are representatives of youth organizations, scientific societies, colleges and the University of Glasgow. Prof. Balfour Brown and Prof. C. M. Yonge, who have connexions with similar organizations in the south of Britain, are also on the Council. The Council is mainly, but not exclusively, concerned with the popularization of field studies. Its membership is widely representative, and includes amateur and professional naturalists, educationists, representatives of the Scottish Youth Hostels Association, Boy Scouts, etc. Its constitution provides it with useful powers of co-option. The Council is anxious to get in touch with other organizations of a similar nature, so that some type of co-operation may be established and there may be a free exchange of ideas. It has already set up panels of lecturers and outdoor guides, and is considering the preparation of guide-books to the natural history of the west of Scotland. The chairman is Prof. John Walton; the honorary secretary is Dr. T. Gregory Absalom, Art Galleries and Museum, Kelvingrove, Glasgow, C.3, to whom communications should be addressed.

Durban Museum and Art Gallery

In the annual report for 1943–44 of the Durban Museum and Art Gallery, it is reported that their position as institutions of visual education and æsthetic enjoyment has been well maintained; but reference is made to the now common need among museums in all parts of the world for further and more suitable accommodation. Besides the usual routine work, many public lectures were given in the Museum and Art Gallery throughout the year, and there was much activity in connexion with the school services. The showing of educational films evidently takes a prominent place in these services. In reference to adult education, it is of interest that the South African Minister of Education appointed a committee to inquire into, and report upon, the part played by the Museum and Art Gallery in this realm of their activities. One of the photographic plates in this report depicts an interesting group of carved stone figures entitled "Baya Huba", by Mary Stainbank; this was recently acquired by the Art Gallery.

Biochemical Research Foundation of the Franklin Institute

In Reports of the Biochemical Research Foundation of the Franklin Institute (**7**; 1942–43), stress is laid on the importance of co-ordination of the sciences of physics, chemistry and biology. By this means it is often possible to obtain a comprehensive view of a problem, whereas the isolated methods of the past would only come to an *impasse*. There are more scientific trained personnel in this Institute than in almost any college, and, free from the burden of teaching, all are co-ordinated and organized towards the special end. Direction of research towards certain projects is thus possible, and groups of scientific workers of varied character together with apparatus of unique quality are brought to bear on the elucidation of any problem. An example of this type of group co-operative work is the successful separation by physico-chemical methods followed by biological study of certain surface antigens of the typhoid bacillus having high immunizing powers without any great degree of toxicity.

Announcements

Mr. Roy Innes has been appointed general secretary of the Association of Scientific Workers. Mr. Innes took a degree in mathematics and physics at the University of Manchester in 1937. For a time he was a science teacher, and in 1939 entered the newly formed Operational Research Section attached to Fighter Command, R.A.F. He succeeds Mrs. Reinet Fremlin, who has been with the Association for eight years.

An open meeting to discuss "Social Security for Chemists" has been arranged by the London Section of the British Association of Chemists. It will be held at the Assembly Hall, Royal Empire Society, Northumberland Avenue, at 6.30 p.m. on September 19.

Voks Bulletin No. 6, of the U.S.S.R. Society for Cultural Relations with Foreign Countries, includes a tribute to Mendeléeff, by M. Pervukhim, People's Commissar of the Chemical Industry of the U.S.S.R., in connexion with the seventy-fifth anniversary of the discovery of the periodic law, and an article by the late A. Fersman, of the Academy of Sciences of the U.S.S.R., on the periodic law and its significance for natural science, in which its bearing on geochemistry as well as on cosmic processes and theoretical chemistry generally are considered.

The following appointments have been made in the newly formed Department of Animal Health at the University College of Wales, Aberystwyth: Mr. R. Phillips, formerly senior lecturer in agriculture, to undertake research in animal husbandry and the administration of investigational centres; Dr. W. C. Evans, at present biochemist to the Inoculation Department, St. Mary's Hospital, London, to be special lecturer in biochemistry; Mr. E. Parker Pollard has been seconded by the Cooper Technical Bureau for research in parasitology; Mr. D. N. Fidler, to be research assistant (animal husbandry); Mr. R. A. Evans, at present of Crooke's Laboratories, and Mr. A. W. Davies, formerly of the Dunn Nutritional Laboratory, Cambridge, to be research assistants (biochemistry); Mr. T. R. Thomas, Carmarthen, to be consulting veterinary surgeon.

It is intended to publish elsewhere a more detailed account of the production and use of the gratings.

W. L. BRAGG.
A. R. STOKES.

Cavendish Laboratory,
Cambridge. Aug. 9.

[1] *Nature*, **154**, 69 (1944).

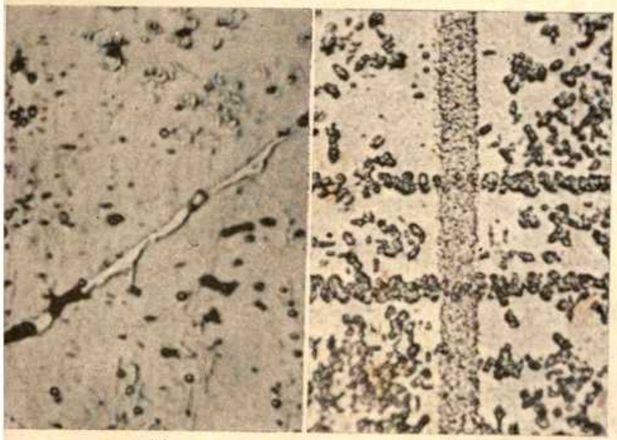
[2] Robertson, *Proc. Roy. Soc.*, A, **142**, 659 (1933).

Striated Structure of Age-hardened Alloys

Drs. Guinier and Jacquet[1] have referred to striated structures appearing in polished specimens, etched or unetched, in the earlier stages of the age-hardening of certain alloys and in particular of aluminium-copper and copper-beryllium alloys.

With regard to aluminium-copper alloys, an extensive research into the mechanism of ageing of high-purity 4 per cent copper-aluminium alloy has confirmed the view I put forward in 1940[2], that these 'striations' could be attributed to accelerated ageing resulting from plastic deformation on quenching, and has again led me to the conclusion that they are not a necessary accompaniment of the age-hardening process. The results I have obtained also show that the lattice-strains, set up in the early stages of ageing by the formation of the Guinier-Preston plates, are relieved when the latter attain a critical size by the precipitation of sub-microscopic copper-rich aggregates and sub-microscopic crystallites of the aluminium solid solution stable at the temperature of ageing. The beginning of the 'flat' on time-hardness curves marks the appearance of this process. As ageing proceeds, these copper-rich segregates and crystallites of aluminium become microscopic in size, as shown in Fig. *a*, which is a photomicrograph of the etched structure of high purity 4 per cent copper-aluminium alloy, quenched and aged 80 days at 130° C. White crystallites of aluminium solid solution, stable at 130° C., are seen in the grain boundaries and in the matrix, together with the black areas which are indicative of copper-rich regions.

Furthermore, Wassermann's[3] suggestion that striated structures may be attributed to mechanical twinning resulting from quenching stresses is not confirmed. Fig. *b* is the photomicrograph of part of a large grain of high-purity 4 per cent copper-aluminium alloy, in which several 'striations' were revealed on etching the quenched and aged specimen. The specific etching reagent has developed the crystallites of the aluminium solid solution, stable at the ageing temperature, as referred to above. The 'striations' are composed of many of these crystallites, and it is clear that where the two bands of striæ cross one another, no change in direction occurs. My researches into the relationship between cold-work and age-hardening show that cold-working (strain-hardening) and age-hardening are similar processes, and that when the lattice has been strained to a critical amount, relief occurs by the formation of crystallites of aluminium along the planes of slip, resulting in accelerated ageing. Hence the crystallites shown in Fig. *b* are due to accelerated ageing in strained areas.



(*a*) (*b*)

4 % COPPER-ALUMINIUM (*a*) AGED 80 DAYS, 130° C.; × 2,000; (*b*) AGED 4 HR., 190° C.; × 1,500.

If quenching is very severe, as it was in the case of the specimen mentioned above, 'striations' are formed; it is probable, however, that they are deformation bands of the type found by Barrett and Levenson[4] in compressed aluminium. The spontaneous development of striations in copper-beryllium alloys is, I think, a different phenomenon; rather they are associated with the development of internal strains in the lattice due to the formation of beryllium-rich zones, as postulated by Guinier and Jacquet, and *not* to plastic deformation. The relief of strains set up takes place in these alloys on a macro-scale, that is, with the formation of striations similar in type to Lüder's lines; in the case of copper-aluminium alloys, the relief of strain in the early stages is on a sub-microscopic scale and is not accompanied by 'striations'.

In the near future I hope to publish full details in support of my statements.

M. L. V. GAYLER.

Metallurgy Division,
National Physical Laboratory,
Teddington, Middlesex.
July 10.

[1] *Nature*, **155**, 695 (1945).

[2] Gayler, M. L. V., and Parkhouse, R., *J. Inst. Met.*, **66**, 67 (1940).

[3] Wassermann, G., *Z. Metallkunde*, **30**, 62 (1938).

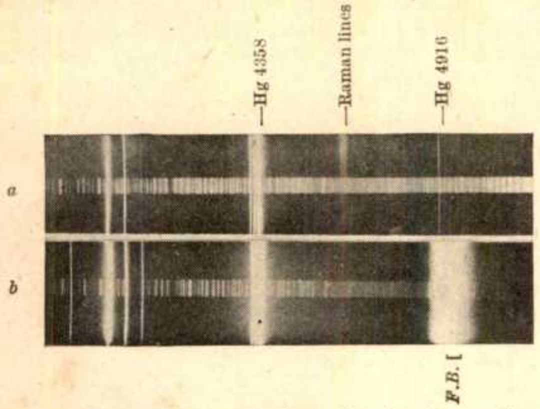
[4] Barrett, C. S., and Levenson, L. H., *Amer. Inst. Min. Met. Eng.*, Inst. Met. Div., **137**, 112 (1940).

Fluorescence of Dipropyl Ketone at Low Temperatures

IT is well known that fluorescence bands sometimes undergo changes in position and intensity with the change of state and temperature of the substance, and also they sometimes show some structure at low temperatures. Organic substances which do not exhibit any fluorescence at room temperature but show intense fluorescence bands at low temperatures are, however, very rare.

While investigating the Raman spectra of organic substances at low temperatures, we have observed that dipropyl ketone is one such substance. When it is irradiated in the solid state at about −170° C. by light from mercury arcs condensed by thick glass condensers, it yields a feeble Raman spectrum containing also a very intense fluorescence band extending from λ 4880 up to λ 5100, the short wave-length edge of the band being less diffuse than the long wave-length edge. The Raman spectrum of the liquid at room temperature observed under similar conditions does not show any appreciable fluorescence in the visible region, as can be seen from the spectrum reproduced; the spectrogram for the solid at about

$-$ 170° C. is also reproduced. It can be seen that the intensity of the fluorescence band is as large as that of the undisplaced mercury lines, even though a narrow slit was used; the undisplaced mercury lines were due to strong stray diffuse light coming from the irradiated mass of the solid, which was translucent.



It has been observed that the band mentioned above does not appear immediately after the double-walled 'Pyrex' tube containing the liquid is completely immersed in liquid oxygen. This shows that the band is not due to liquid oxygen. The substance freezes at $-$ 32·6° C., but the band does not appear even when the liquid is solidified and the temperature goes down below $-$ 50° C. As the temperature is lowered further, a feeble continuous fluorescence extending from λ 4920 up to about λ 5300 is observed, and when air at atmospheric pressure is allowed to fill up the annular space between the walls of the double-walled container, the temperature of the solid attains a value of about $-$ 170° C. and the intense band shown appears simultaneously. Visual observations show also the presence of a very weak diffuse and broad band at about λ 5200; but owing to the insensitivity of the plate in this region this band has not been recorded on the plate.

The facts mentioned above indicate that change of state of the substance is not responsible for the origin of the band. It is the contraction of the solid at lower temperatures which gives rise to the strong fluorescence. Thus probably this fluorescence of dipropyl ketone furnishes direct evidence of the appearance of fluorescence due to strain in the molecular lattice. The investigations are being pursued.

S. C. SIRKAR.

Physics Department,
University of Calcutta.

B. M. BISHUI.

Indian Association for the
Cultivation of Science,
Calcutta. April 28.

Hydrogen Bond Linking of Quinol Molecules

CRYSTAL structure examination has shown that quinol molecules may link by hydrogen bonds in a special manner. The compound $SO_2.3C_6H_4(OH)_2$ [1] is found to have a rhombohedral lattice; the corresponding hexagonal unit cell, $a = 16{\cdot}3$, $c = 5{\cdot}8_1$ A., contains nine molecules of quinol and three of sulphur dioxide. From X-ray intensity relationships and absent spectra, the evidence of face development, and the negative results of pyro-electric and piezo-electric tests, the space group should be $R\bar{3}$. For β-quinol, Caspari[2] found a unit cell of very similar dimensions, without a centre of symmetry, and of the possible space groups C^1_3–$C3$ and C^4_3–$R3$ preferred C^1_3–$C3$; a determination of atomic positions was not attempted. We have confirmed the polar character, but from absent spectra find the space group to be C^4_3–$R3$. From the great similarity, after allowance for the sulphur dioxide, between our X-ray data for β-quinol and the sulphur dioxide compound, the two structures must have much in common. As a safeguard, therefore, against erroneous conclusions due to faulty space group suppositions, the structure of the sulphur dioxide compound was developed, without the initial assumption of centrosymmetry, by three-dimensional Patterson and Fourier methods. In the early stages this procedure brought in a symmetry centre, and for the subsequent work the space group was taken as $R\bar{3}$ in accordance with this and the other evidence.

The linking of quinol molecules in this compound may be seen from Figs. 1 and 2. In Fig. 1, circles represent oxygen atoms of the hydroxyl groups linked by hydrogen bonds to form approximately plane hexagons of side 2·7 A. These hexagons are connected as shown through rods which represent the quinol molecules. For clarity the benzene rings have been omitted, and the rod itself coincides with the line joining the two oxygen atoms of one molecule. This gives a set of quinol molecules linked to form an infinite cagework in three dimensions. Although the hexagon is a satisfying hydrogen bond arrangement, having a parallel in the crystals of boric acid[3], and the oxygen to carbon link represented by the direction of the rod is at nearly the tetrahedral angle to the two hydrogen bonds as is commonly the case, the molecular grouping of Fig. 1 is a very ineffective one for space filling. Comparison with the 2·7 A. sides of the hexagons will show a very large central space and, on each face of the roughly rhombohedral framework, gaps which are wide compared with an atomic diameter. These gaps are so large that it is possible to insert a second identical framework. This is displaced vertically half-way between the top and bottom hexagons, and the holes of the structure are such that the two cageworks are able to interpenetrate each other without closer contact than that usual for unlinked atoms. A drawing cannot represent this owing to overlap effects, but the stereoscopic representation of Fig. 2 gives a simple visual demonstration of the relative dispositions of two frameworks each identical with that of Fig. 1, but viewed from a different angle for convenience.

Although the two frameworks now approach to give normal van der Waals distances and there are no gaps

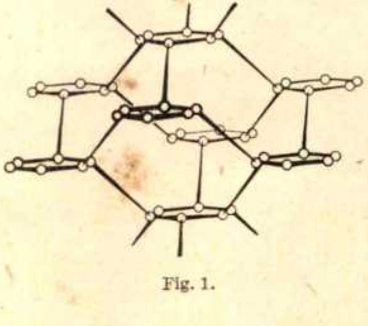


Fig. 1.

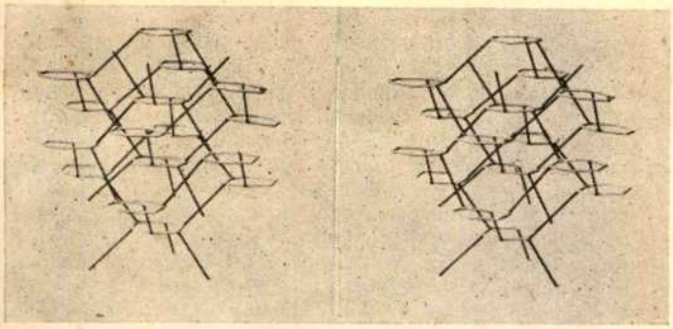


Fig. 2. THE STEREOSCOPIC EFFECT MAY BE OBTAINED BY USE OF A SIMPLE STEREOSCOPE, FOR EXAMPLE, HILGER'S, OR BY HOLDING A CONVEX LENS OF FOCAL LENGTH c. 10 CM. CLOSE TO EACH EYE.

through which a molecule may easily enter or leave, there remain, between the two cageworks, cavities of sufficient size to contain a small molecule at normal unlinked distances from the surrounding atoms. These cavities, which may be seen in Fig. 2, are bounded at top and bottom by the hydrogen bond hexagons of the two different cageworks and at the sides by quinol molecules as a whole. It is in these separate enclosures that the sulphur dioxide, or other molecule in similar compounds, is located.

The detailed structures of the compounds and a discussion of applications of the type of union exemplified will be given elsewhere.

Note added in proof. Our unit cell dimensions, slightly greater than Caspari's, led to further work including a molecular weight determination from unit cell size and density, comparison of X-ray intensities and chemical analyses, all of which show that 'β-quinol' crystallized from methyl alcohol is a compound containing one molecule of methyl alcohol to three of quinol and is thus closely related to the sulphur dioxide compound.

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[2] Caspari, W. A., *J. Chem. Soc.*, **130**, 1093 (1927).

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Degree of Association of Water from the Energy of Viscosity and the Work of Cohesion

ON a previous occasion[1], it has been shown that the energy of viscosity equals the work of cohesion for non-associated liquids. For associated liquids the energy of viscosity is greater than the work of cohesion by a definite increment. This increment of energy is the energy of association per bond between two associated molecules. Equating the difference between the energy of viscosity, $E_{\text{visc.}}$, and the work of cohesion, W_c, to the energy of attraction between two interacting dipoles, it is possible to calculate an apparent dipole moment of the molecule, and from the apparent dipole moment one can calculate the degree of association of the substance. Thus it is postulated that for a liquid where all the dipoles take part in association complexes,

$$\frac{E_{\text{visc.}} - W_c}{N} = E(r)_{\text{dipole interaction}} \quad . \quad . \quad (1)$$

where $E(r)_{\text{dipole interaction}}$ is the energy of interaction between two dipoles.

This energy of interaction between two dipoles results from the summation of two effects: (*a*) the attraction between the dipoles[2] (the so-called orientation effect); (*b*) the mutual enhancement of the dipole moments of the molecules by mutual interaction, due to the polarizability of the molecules[3].

Let μ be the dipole moment of the molecules, r the distance between the centres of the dipoles and p the polarizability of the molecules; then for a parallel arrangement of the dipoles:

$$E(r)_{\text{orientation}} = \frac{\mu^2}{r^3};\ E(r)_{\text{polarizability}} = \frac{2.\mu^2.p}{r^6}; \quad . \quad . \quad (2,\ 3)$$

and

$$E(r)_{\text{dipole interaction}} = E(r)_{\text{orientation}} + E(r)_{\text{polarizability}} \quad . \quad (4)$$

From equations (1) to (4) it follows that

$$\mu = \sqrt{\frac{E_{\text{visc.}} - W_c}{N} \cdot \frac{r^3}{1 + 2p/r^3}} \quad . \quad . \quad (5)$$

If all the dipole molecules would form association complexes, then equation (5) would give the true value of the dipole moment. However, the difference between $E_{\text{visc.}}$ and W_c derives only from the fraction of the molecules which take part in the associated complexes. If the liquid is only partially associated, equation (5) will give an apparent dipole moment smaller than the 'true' or experimentally determined moment.

Writing

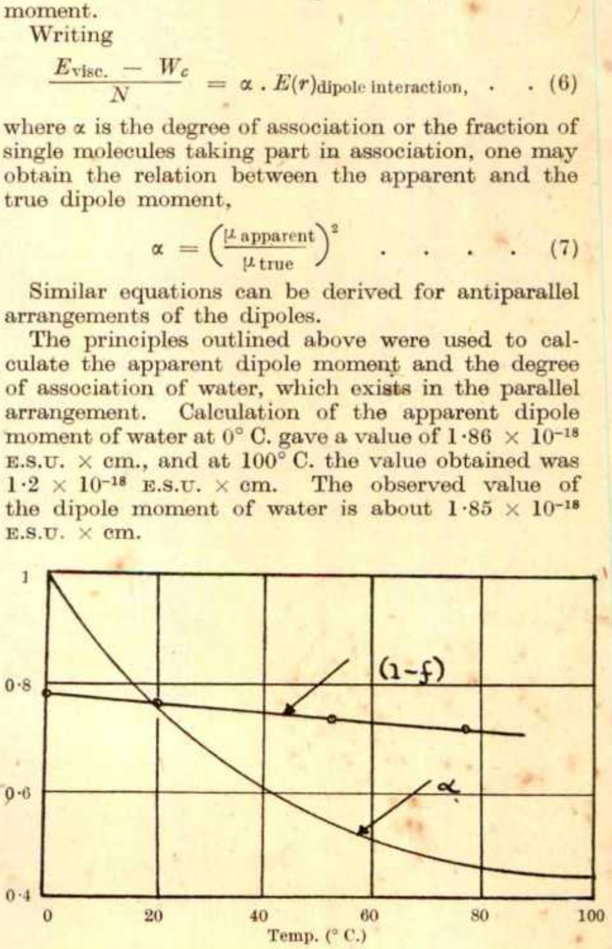
$$\frac{E_{\text{visc.}} - W_c}{N} = \alpha\ .\ E(r)_{\text{dipole interaction}}, \quad . \quad . \quad (6)$$

where α is the degree of association or the fraction of single molecules taking part in association, one may obtain the relation between the apparent and the true dipole moment,

$$\alpha = \left(\frac{\mu_{\text{apparent}}}{\mu_{\text{true}}}\right)^2 \quad . \quad . \quad . \quad . \quad (7)$$

Similar equations can be derived for antiparallel arrangements of the dipoles.

The principles outlined above were used to calculate the apparent dipole moment and the degree of association of water, which exists in the parallel arrangement. Calculation of the apparent dipole moment of water at 0° C. gave a value of $1{\cdot}86 \times 10^{-18}$ E.S.U. × cm., and at 100° C. the value obtained was $1{\cdot}2 \times 10^{-18}$ E.S.U. × cm. The observed value of the dipole moment of water is about $1{\cdot}85 \times 10^{-18}$ E.S.U. × cm.



The degree of association of water was then calculated and the results are shown on the accompanying graph. According to our calculations, near the melting point water is completely associated (that is, every molecule takes part in associated complexes), while at the boiling point only 42 per cent of the molecules behave in this manner. It is interesting to compare the values of α with the fraction of the dipoles, f, which have free rotatory power as given by Bernal and Fowler[4]. The values of $(1 - f)$, the fraction of the dipoles having no free rotatory power, are given graphically.

At present work is in progress to apply these principles to other substances and to the mechanism of viscosity.

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The Fitzgerald Contraction as the Origin of our Experience of Time and its Lapse Rate

LET it be assumed that the origin of the sensation of time and the flux of time lies in the Fitzgerald contraction of brain material. If the brain material is carried relatively to 'space' or 'ether' with constant speed, the sensation will be steady in amount, and so the flow of time will seem to be uniform. For all speeds of motion the contraction is a well-known function of the speed, and it is the most simple postulate that the sensation of the lapse-rate of time is altered correspondingly.

Sir James Jeans has advanced the postulate that the brain is responsive to the one-way increase of entropy. This is possible and perhaps plausible in virtue of the magnitude of the individual brain mechanism attached to a centre of brain response; but it must be remembered that entropy flux can only be presumed to be steady as an average. There is no such limitation in the case of the Fitzgerald contraction. Its action is one-way unavoidably.

Using Maxwell's equations in the form

$$\text{Curl } E + \dot{B} = 0 \text{ ; div } B = 0 \text{ ;}$$
$$\text{Curl } H - \dot{D} = 0 \text{ ; div } D = 0 \text{ ;}$$

which characterize Schrödinger's recent treatment[1], that treatment makes clear the possibility of employing Maxwell's electromagnetic theory in the wave mechanics of the present day.

By accepting only data susceptible of ideal or actual demonstration, a possible large and fruitful line of investigation is closed, and we are faced with the complicated picturization of reality as given in terms of relativity and quantum wave mechanics. The existence of ether has been denied and 'space' enthroned instead. As Sir J. J. Thomson, in forming an ideal working model of the proton in ether, asks: Why not call it ether instead of space and get rid of the difficulty? Schrödinger's suggestions repeat the demand with the additional simplification of the explicitly stated quality of Maxwellian.

In this connexion we have to regard afresh the striking announcement given to the International Congress of Physics at Paris in 1900 by Kelvin, at once of his renunciation of the longitudinal component of the electric displacement in wave motion through the ether; of his adoption instead of Maxwell's electromagnetic ether; and of his final adherence to Boscovich's theory of the action of forces, of electric attraction or repulsion as providing a basis for the connexion of matter with ether.

In this way, Kelvin brought to a triumphant conclusion in 1900 his work on wave-theory, matter, and ether, begun in his Baltimore Lectures in 1884, and continued intermittently throughout the intervening years. This was perhaps the greatest investigation made in theoretical physics since Newton wrote. It vindicated the claim that investigators in physics should not be trammelled by the modern arbitrary restriction. The picture of Nature they give may actually lie nearer its heart.

Now, with this claim made prominent, what, more fully, of the picture of Nature presented by Kelvin? Primarily, the Maxwellian ether, having negative compressibility and made stable by atomic support in a material medium built up of these atoms. If a physicist of Kelvin's rank was satisfied with that, it should surely give confidence.

Finally, let this ether be that part of the ether contemplated by Schrödinger[1], corresponding to Maxwell's electromagnetic equations. We need only consider the four dimensions of ether, three mutually perpendicular to each other in our own universe, and one normal to those in the fourth dimension. Regard the ether flux as entering the three-dimensional model, contemplated by Schrödinger, from the fourth dimension, and we can regard the working of the model as due to the energy carried into the model by the etherial current. There is no need to contemplate as existing in reality any higher order of ether dimensions than four. To consider space-time only complicates the picture of reality offered to us.

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The Weisha, Ninewells,
Dundee. May 18.

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Bread in Jersey during German Occupation

THROUGH Mr. E. F. Mitchell, president-elect of the National Association of Master Bakers, Caterers and Confectioners, we received a sample of bread made in Jersey during the German occupation. The analytical data we obtained on this sample will probably be of interest to many.

The bread was naturally stale and dry, so that it is possible, in view of the moisture content (10·9 per cent), to compare the figures obtained directly with those of flour or meal. The bread had the disadvantage of being very dark and unappetizing, while it did not have the advantage of a high vitamin B_1 content usually associated with dark and long-extraction bread. Actually, the vitamin B_1 figure is no higher than that of the present fairly good coloured 80 per cent flour, which has about 0·80 I.U./gm. The riboflavin is also not especially high; but the nicotinic acid content is substantially higher than that of present-day flour in Great Britain.

It will be observed that the bread has a very high fibre content, due to the presence of some very coarse fibrous material. We have examined a portion of this material sieved out from the flour. It is not of the nature of bran and appears to be just coarse extraneous fibrous material. We are informed that 3–4 per cent of such material can be easily sieved out of the flour without removal of bran. It had a fibre content of more than 16 per cent and a vitamin B_1 content of only 1·0 I.U./gm. The presence of this material naturally reduces the digestibility of the bread.

	Bread received from Jersey %	Present-day 80% flour %
Moisture	10·88	13·50
Protein (N × 5·7)	8·27	11·40
Ash	2·71*	0·75
Oil (by hydrolysis)	0·81	1·80
Fibre	2·87	0·20
Carbohydrates and undetermined matters (by difference)	74·96	72·35
	100·60	100·00

* This contains 1·69 per cent salt

	Bread received from Jersey.	Present-day 80% flour
Vitamins—		
B_1	0·77 I.U./gm	0·80 I.U./gm.
Riboflavin	0·82 μgm./gm.	0·60 μgm./gm.
Nicotinic acid	36·0 μgm./gm.	16·0 μgm./gm.

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Progressive Clines

THE geographical regularities of variation, including the well-known examples subsumed under Bergmann's and Sloger's rules, have been receiving much attention from recent writers on evolutionary subjects, under the general head of 'clines'. However, the type of cline involving increasing specialization in a given geographical direction, although first described more than forty years ago, seems to have been entirely neglected in these discussions.

In 1902, Leche[1] in discussing the hedgehogs (*Erinaceus* s.l.) pointed out that within three of the groups into which he divided them, the geographical representatives showed an increasing specialization as one proceeds from North India towards North Africa. (He was apparently mistaken as to the affinities of form, but the correction only makes the case still more convincing[2].)

As a result of careful studies of the horseshoe bats (*Rhinolophus*), Knud Andersen[3,4] arrived at similar conclusions. The Ethiopian forms are less primitive than their relatives farther east, notably in the following characters: (1) the reduction of certain premolars (a general tendency in bats); (2) specializations of wing-structure (here his conclusions were confirmed by Revilliod[5]); and (3) detailed structure of the nose-leaves. Disregarding the last point, the value of which as an indication of evolutionary level may be questioned, we can still say that wherever such differences are demonstrable, forms from Africa and the Western Palæarctic are more specialized than their nearest relatives in the Oriental region. In this genus, forms from the western and eastern areas are seldom conspecific, and there is often considerable geographical overlap. Evidently, barriers to intercrossing are very easily developed even between closely related groups in *Rhinolophus*, thus accounting for the astonishing number of species in the genus.

The most important of a number of examples cited by Leche in a later paper[6] concerns the porcupines of the genus *Hystrix*. Thus the enlargement of the nasal region (which is already marked in *H. brachyura* from the Malayan region in comparison with more primitive genera) is much more extreme in the Mediterranean *H. cristata*, where the nasals cover more than half the dorsal surface of the skull, and (together with the frontals) are enlarged vertically by air sinuses. Indeed, the erection of a separate genus *Acanthion* for *H. cristata* would be quite justified were it not for the almost complete chain of intervening forms in India and Western Asia. There is no geographical overlapping between these, and it may be possible to consider all of them as forms of one polytypic species or super species.

For character-gredients of this sort, which unlike the usual ones clearly pertain to different evolutionary levels, I propose the term progressive clines, in accordance with the cline terminology introduced by Huxley[7].

Whereas Leche and Andersen both considered this phenomenon as migration in the direction of the more advanced forms (that is, from east to west), I have proposed an alternative explanation[8], namely, the far greater climatic changes during the Tertiary in the western part of the Old World, as opposed to the relatively stable conditions in the Far East. Further, owing to the Atlantic acting as an outlet to the drift ice during the Glacial Period[9], the land masses bordering on that ocean have also been subject to a maximum of climatic change during the Pleistocene. In regard to man, Hazayyin[10] has emphasized the importance of these changes in stimulating the evolution of Palæolithic cultures, which have an important centre of dispersal in the Saharan region. In other organisms the influence of changing conditions upon the rate of evolution is generally recognized, and has been confirmed by modern theory. Furthermore, division of a species into several more or less isolated populations is also favoured by severe conditions, and this tends to produce the same effect[11].

A cline such as that found in *Hystrix* might be termed an orthogenetic series, but that the occurrence of the most advanced forms in the region where external factors known to favour rapidity of evolution are most pronounced makes it unnecessary to assume the operation of orthogenesis in the sense of a hypothetical immanent force or agency.

A final decision as to whether these clines have anything to do with migration or not is possible only from very full palæontological data. The few cases where we have some information of this sort are not favourable to the migration theory.

The red deer of Europe is generally believed to be descended from the closely related Tibet stags, with more primitive antlers; Central Asia is therefore regarded as the original home of the group. Recently, Beninde[12] described a deer from the Lower Pleistocene of Mosbach, *Cervus acoronatus*, which is apparently directly ancestral to the recent European species, and almost identical with one of the Tibet stags, *C. macneilli*, the latter being slightly more advanced[13]. This seems to prove that the higher specialization of *C. elaphus* was not correlated with a westward migration from an eastern origin; it may just as well have had a western cradle, whence, as *C. acoronatus*, it spread eastwards. It is significant that the region adjacent to the eastern border of Tibet, where *C. macneilli* occurs, is an important refuge for primitive forms (for example, *Uropsilus*, the giant panda).

Secondly, the European badger (*Meles m. meles*) may be considered more advanced (in the excessive broadening of the upper molars) than the races of Asia Minor (*M. m. ponticus*[14]) and Persia (*M. m. canescens*[15]). But even as recently as the earliest Neolithic of Denmark, some eight thousand years ago, the badgers of this country were more primitive in this respect, approaching the Asiatic forms[16].

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South African Onychophora

ATTENTION has been directed in the Research Items in *Nature* of May 26 to a paper by Holliday[1], on the habits of South African Onychophora, *Opisthopatus cinctipes* and *Peripatopsis Moseleyi*, from Natal. Both this work and an earlier publication by the same author[2] have dispensed with the custom of reference to published literature.

A number of subjects are dealt with, but in nearly every case the facts described have long been known and in recent years much research has been directed to them in Britain. The note in *Nature* directs attention to Holliday's observations on the season of birth of *P. Moseleyi*, and to the number of young born per year; to the new-born young eating their first moult; and to the covering of food by saliva and the probability of at least partial liquefaction of the food before ingestion.

The months of birth and the number of young of *P. Moseleyi* was published by Purcell in 1900 for Natal[3], and data for other localities by Manton[4] in 1938. The fact that *Peripatus* usually eats its moulted integument has been established for many years (Steel, 1896[5], and others). A very much more detailed account of the feeding mechanism, use of saliva, the ingestion of both solid and liquid food, the nature and mode of action of the digestive enzymes of the salivary and intestinal juice, etc., has been published by Heatley[6], and Manton and Heatley[7]. Concerning the drinking by *Peripatus*, Holliday makes no reference to the much fuller treatment of the control of water-loss and the occurrence of drinking by Manton and Heatley[7], and Manton and Ramsay[8].

Work on the South African Onychophora has been going on in Britain for the past twelve years. Four species were brought to England alive in 1933 and two species lived in the Zoological Laboratory, Cambridge, for four years after removal from their native haunts.

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[1] Holliday, R. A., *Ann. Natal Mus.*, 10, 433 (1944).

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Use of Stereographic Projection for Statistical Problems

MR. NAYLOR's recent article[1] on an approximate method for estimating multiple correlation should direct attention to the many possible uses of projection methods in statistical work. The proof that he quotes from my lengthier and more accurate procedure referred primarily to the substitution of a stereographic projection in demonstrating Pearson's equations for correcting for selection[2]: the special problem of partial correlation was treated as an extreme case of selection. (There is incidentally an unnoticed error in Pearson's own diagrams; his placing of D and G relative to E and F violates the conditions of consistency which must obtain for correlations between three real variables.)

I should, however, point out that the formulæ that follow from my proof differ somewhat from those reached by Mr. Naylor. He assumes that it is only "*beyond the first combination*" (his italics) that "the partial regressions are not quite equal to the partial correlations". But even partial regressions of the first order cannot be identified with the corresponding partial correlations. Hence his equation for the proportionate weighting of A and B should read.

$$\frac{\text{Weighting for } A}{\text{Weighting for } B} = \frac{b_{CA.B}}{b_{CB.A}} = \frac{\cos B \sin CB}{\cos A \sin CA} = \frac{\sin PB}{\sin AB}$$

Thus, the weights should be proportional, not to the angles at the base (as he states), but to the segments into which the base AB is divided.

From the equation in this form it is quite possible to build up *exact* expressions for multiple correlations of a higher order. As his note implies, I have found both globular and stereographic projections a useful aid for illustrating these formulæ; but for practical computation I am doubtful if either the exact or the approximate procedures are really superior to the more familiar devices in common use.

For laboratory work we have used printed stereographic nets (obtainable from T. Murby and Co., now Allen and Unwin, Ltd.) and a boxwood stereographic scale (from C. F. Casella and Co., Ltd.). But for correlational studies (for example, rotation of factors) it would be helpful if the nets and scales could be marked in terms of cosines rather than of angles.

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[1] *Nature*. **156**, 58 (1945).

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RELATION OF THE GONADAL HORMONES TO CERTAIN DERMATOSES*

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IN this article those dermatoses arising from female gonadal hormone disturbances are described. It goes without saying that other hormones may be involved in like cases, and that hormonal dysfunction can also be a factor in dermatoses in men. The description is limited to women because in them the origin of hormonal dermatoses is often demonstrated by accompanying genital dysfunction due to disturbance of hormonal balance or to hormone deficiency, which can be corrected by synthetic hormone therapy to give results which are striking enough to confirm the diagnosis.

Varied though they are, the dermatoses considered here represent only a few of the aspects of the bearing of the hormones on the skin, which, as Novak has said, "is directly and precisely influenced, as is no other tissue to the same extent, by modifications in the genital system".

Eczema. This is a dermatosis in which a gonadal hormone factor is often demonstrable. I have already related to the Société de Dermatologie[1] two observations which demonstrated, first, the importance of hormonal imbalance in certain eczemas, and secondly, the bearing of this factor in the treatment of these diseases which often resist the ordinary remedies but are cured by injections of the requisite hormone. Both cases were in young women who gave long histories (twelve years in one, six in the other) of chronic eczema of the backs of the hands and wrists. Although they both had shown phases of improvement alternating with aggravation, their skin lesions had never completely disappeared except during pregnancy. In both cases the eczema had cleared up at the beginning of pregnancy only to reappear again a short time after term. Both patients had normal menstrual cycles and gave histories of premenstrual aggravation and post-menstrual attenuation of the disease. Although these cases were clinically identical, one was cured with œstrone and the other with progesterone. Basically, however, the same mechanism was involved in both cases, namely, a disturbance of balance between the hormones of the follicle and corpus luteum, and restoration of balance produced a cure.

In other cases the cause is a hormonal deficiency rather than an imbalance, as in the case of eczema due to a natural or artificial (surgical) menopause which can be cured by injections of œstrone.

The male hormone can also be used as an anti-œstrogen in the treatment of eczema and other dermatoses. Lafitte and Huret[2], and Lortat-Jacob[3], have had good results from the use of testosterone in certain eczemas of women who presented signs of œstrogenic over-activity.

Psoriasis. The chronicity, resistance to treatment and frequent relapses of psoriasis are well known. The use of hormones has figured among the researches made to find an efficacious treatment.

As far back as 1923 Spilmann, Parisot and Simonin[4] published an observation showing the possibilities in this idea. Their case was a woman who had twice seen her psoriasis disappear completely during pregnancy. Spilmann and his collaborators collected blood from her during the second pregnancy, and when the psoriasis returned three months later, they were able to cure it by injections of the patient's serum which had been kept in a refrigerator. They had, in effect, applied indirect hormonal therapy, and Spilmann, in a later article, suggested that the active principle had been the luteal hormone.

There are some cases of psoriasis which appear at puberty, and others which follow the menopause. It seems reasonable, in such cases at least, to investigate the possibility of a hormonal deficiency or imbalance.

Acne. This is a dermatosis which is obviously related to sexual development. It is never seen before puberty and its connexion with genital dysfunction is well known.

In juvenile acne I have seen good results follow the use of gonadotropic hormones.

The same is not the case in the acne of middle-aged women or of the menopause, when a direct action of the gonadal hormones can be demonstrated. Then it is sometimes a question of an acne of the rosacea type with small papulo-pustules seeded among varicosities of the cheeks and nose (relapsing miliary acne of Brocq). Often these papulo-pustular lesions are localized on the chin where some become indurated and evolve slowly. This localization of acne on the chin in women was known to the dermatologists of old as indicating ovarian dysfunction. In other cases of this type acne with large indurated elements is associated with rosacea. These two forms are frequently seen in women approaching the menopause, or in castrates. Injections of anti-œstrogenic hormones seem to give the best results.

Jausion, who attaches much importance to the role of staphylococcus albus in acne, has shown that this organism grows well on media containing hormones, and states that it grows best in sebum the composition of which resembles that of the sexual sterones.

Herpes simplex. The recurrent type of herpes in women often appears at the time of menstruation. It is probable that hormonal imbalance favours the appearance of this disease which is directly caused by a filterable virus. In most sufferers from recurrent herpes related to menstruation the lesions are trivial, and patients are seldom found who feel it necessary to submit to hormonal treatment.

Pruritus Vulvæ. Rebellious to treatment, long-continued and sometimes so intense as to produce obsession or even suicide, vulval or ano-vulval pruritus occurs at different stages in the sexual history: during the active phase and also at the menopause.

Many German authors (Seitz, Kaufmann, Rust, etc.) have described good results from the use of œstrogenic hormones in the treatment of this condition at the menopause, and I can confirm this in a large number of cases. On the other hand, I have never had the success claimed by these authors by using ointments containing œstrone.

Unlike the other dermatoses already described,

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* First published in *La Presse Médicale*, June 30, 1942. Translated by Dr. James Marshall.

in pruritus there is almost always a deficiency of œstrone and by replacement therapy cures are obtained which are the more striking in stubborn cases of long standing and accompanied by breakdown in general health.

Lichenification. There have been described cases of circumscribed lichenification (névrodermites) of hormonal origin. In the cases I have observed hormone therapy has produced at best only an improvement in the condition. I have, however, had one case of diffuse lichenification of the thighs in which progesterone caused a very marked improvement[5].

Relapsing Erythema Multiforme. This is a rare type of hormonal dermatosis corresponding to the 'dysmenorrhœic dermatitis' of the Germans, of which I have elsewhere recorded a case[6].

The dermatoses described above are those in which I have been able to define a relationship to the gonadal hormones. There exist others, no doubt, and Desaux[7] has collected a series of cutaneous reactions which he ascribes to hyperœstrinism.

What, then, are the requirements for postulating a hormonal basis in a case of this type? Most important are a history and clinical findings of associated genital dysfunction. With many others I believe that estimation of urinary and blood hormone levels and biopsy of the endometrium are of doubtful value in diagnosis.

The best approach is from the clinical angle. One must discover by careful questioning symptoms of genital functional disturbance which the patient is unlikely to volunteer in connexion with the dermatosis which caused her to seek attention. Any relation between evolution of the lesions and the menstrual cycle must be discovered, for example, premenstrual or intermenstrual exacerbations, or regressions at these times; disappearance of lesions during pregnancy. A detailed menstrual history is essential. One must search for evidence of the clinical syndrome of hyperœstrinism described by the gynæcologists and which, according to Séguy, is characterized by (*a*) intense and painful mammary congestion; (*b*) intermenstrual pain localized in one or both ovaries, which may become palpably enlarged; (*c*) a clear cervical secretion increased in amount and duration over the normal; and (*d*) intermenstrual metrorrhagia. In these cases the periods are usually painful and copious, with clots of blood and mucus, and are spaced every 21 days or even less. In other cases, on the contrary, there is a marked diminution in the menstrual flow, going on at worst to the hyperhormonal amenorrhœa of Zondek.

Unfortunately it is impossible precisely to tabulate the dermatoses with corresponding hormonal deficiencies, excesses or imbalances. There remains, however, therapeutic test: a cure resulting from the injection of a given hormone is good evidence of relationship. Empiricism still has a large part to play in the field of hormonal dermatoses.

Conduct of treatment. It is impossible to lay down hard and fast rules, but certain general principles must be remembered: (1) More dermatoses are related to hyperœstrinism than to a deficiency (relative or absolute) of œstrone. (2) The anti-œstrogens (progesterone, testosterone) are more easily regulated than the œstrogens, the effects of which are sometimes paradoxical or unexpected. (3) While œstrone is a very active substance, progesterone and testosterone are feebly acting anti-œstrogens. In other words, one must use the latter substances in much larger doses than the former.

It is to be noted also that, in certain cases, a dermatosis which has once yielded to, let us say, progesterone can later become resistant to this hormone, but can be alleviated by œstrone. Such necessary therapeutic changes are explained by postulating an alteration in the state of hormonal imbalance. Similar states have been noted by Chiray and his collaborators in certain asthmas of hormonal origin.

Finally, if one wishes to attempt a rapid treatment, which will at the same time establish the diagnosis, one must administer the chosen synthetic hormone by injection, and leave aside oral treatment, in the early stages at least.

The following scheme can be used as a practical guide.

1. *Dermatosis with intermenstrual exacerbations.* (*a*) With evidence of hyperœstrinism: Use testosterone as an anti-œstrogen during the first ten days of the cycle, in doses of 10 mgm., every other day for four or five injections. (*b*) With no evidence of hyperœstrinism: Use moderate doses of œstrone, for example, 3–5 injections of 1 mgm. during the eighth to fifteenth days of the cycle. Beware of high dosage.

2. *Dermatosis with premenstrual exacerbations.* (*a*) Hyperœstrinism is usually the cause: prescribe 3–5 injections each of 10 mgm. of progesterone over the nineteenth to twenty-sixth days of the cycle. (*b*) Excess of the luteal hormone is sometimes present, and may be absolute, or relative, due to œstrone deficiency in the latter half of the cycle. It is in such cases that anti-œstrogens have a paradoxical effect and provoke a premenstrual mammary swelling. Œstrone should be used in relatively large doses, for example, 15 mgm. in three injections over the last eight days of the cycle.

3. *At the menopause.* (*a*) Natural menopause: Use œstrone, at first in small doses (1 mgm. per injection), and progressively raise the dose to reach finally a total of from 10 to 20 mgm. per month, depending on the symptoms and on the effect obtained. If œstrone is badly supported (in women with menopausal hyperœstrinism), change to testosterone giving three 10 mgm. injections per week, every other week. Some cases may be found to react better to the acetate of testosterone than to the propionate. The dosage is the same for both. (*b*) Artificial menopause (surgical or X-ray). In these cases vaso-motor symptoms (flushes, palpitations) and recrudescences of extra-genital disorders conform to a menstrual rhythm. Progesterone should be given by injection to a total dosage of 30 to 40 mgm. per month, during the fortnight preceding the appearance of each menstrual syndrome.

In the last two cases (3(*a*) and (*b*)), treatment must be long continued as it is a true replacement therapy.

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[1] Garnier, *Bull. Soc. franç. de derm. et syph.*, 319 (March 1939).

[2] Lafitte and Huret, *La presse méd.* (March 29, 1939).

[3] Lortat-Jacob, *Paris-méd.* (Jan. 6, 1940).

[4] Spillmann, Parisot and Simonin, Réunion derm. de Nancy (May 12, 1923).

[5] Garnier, *Bull. Soc. franç. de derm. et syph.*, 128 (Feb. 1941).

[6] Garnier, *Bull. Soc. franç. de derm. et syph.* (Feb. 1940).

[7] Desaux, *Arch. Hosp.*, No. 5 (1939).

PRACTICE OF MEDICINE IN THE UNITED STATES

IN January, 1943, the Council of the New York Academy of Medicine appointed a Committee on Medicine and the Changing Order, which was charged with the study of the economic and social changes which are now taking place or are likely to occur in the future, with the question of how these changes may affect medicine and how the best possible medical care may be made available to the largest number of people at the lowest possible cost. This Committee, composed of representatives of the physicians, dentists and nurses and of laymen belonging to industry and various professions, has issued an interim report (2 East 103rd St., New York, 1945). A final report is expected early in 1946.

During its twenty-two months of activity, the Committee held weekly conferences at which it was addressed by experts. The list of speakers shows that a wide field was covered, for economists, historians, publicists, bankers, industrialists and representatives of labour were among those invited. Other weekly conferences studied medical education, hospital problems, rural and industrial medicine, public health and problems of dentistry and nursing. Monographs on major current socio-medical problems were planned to treat contemporary medicine in all its aspects, and some of these are well on the way towards completion; some short treatises have already been published.

Defining its approach to its problems, the Committee states that medicine carries definite moral and social responsibilities. Modern medical problems have been accentuated by recent economic and social dislocations and have been long in the making. Complicated and costly as its administrative structure now is, medicine has its own history and has continuously tried to improve its science and practice. It has largely depended upon benevolence and charity; this dependence has benefited it, but has created many of its present difficulties. Medicine obviously cannot, without great harm, allow its progress to be governed by profit and loss, and it cannot compromise with quality. There is a widespread demand for good medical care which costs as little as possible, so that medicine cannot continue to work as it has done. If the quality of medicine is to be maintained, medical education and research are basic problems, and laymen must understand what medical education involves. The present curriculum needs revision. Its duration is ever increasing, so that from seven to nine years are spent in training and often several more years in specialized study, so that the medical man begins practice at an advanced age with a large capital investment and a relatively short time in which to recover it. These problems are more important than they appear, and efforts must be made to enable the medical practitioner to become productive earlier without adversely affecting his training. The rapidity of scientific development imposes an increased need for post-graduate education and refresher courses, and this need will increase in the future.

The quality of medical practice is also largely dependent upon public understanding and demand, so that people cannot obtain the full advantages of modern medicine without the intelligent and informed co-operation of the public. Hospitals present major problems. They not only treat the sick, but have also essential educational functions, and any changes made in hospital organization involve numerous factors. The medical man, moreover, nowadays does more than treat the sick; he may look after those who are well, or serve schools, industry, insurance companies, public health and so on; all these activities need planning according to possible future developments. Preventive medicine must also be carefully planned. The economic problems of medicine are complex, but real economy in medical care comes from the quality and competence of the treatment rather than from expenditure upon illness. It is therefore likely that better treatment, even though it costs more, will be the cheaper in the long run. Fewer illnesses rather than lower fees may prove to be the solution.

Current efforts to cure human ills by massive doses of social legislation are full of great dangers, the greatest being the fact that laudable ends will be betrayed by incompetent means used to gain them. Social legislation has, in itself, no power; it must have practical ends and means. Based upon wishful thinking, it can be harmful. We need precise definition of the factors involved and workable proposals which will effect progress. Experiments in various forms of medical care must obviously be undertaken before legislation is attempted.

With all these principles and attitudes of mind, somewhat nebulous though they are, many British medical men will agree. Most of them are, indeed, reflected in recent British plans for the reform of medical education which have been noticed in these columns (see, for example, the report of the Goodenough Committee on Medical Schools and the report of the Committee of the Royal College of Physicians of London, *Nature*, **154**, 315 and 322; 1944). Everywhere in the world the problems confronting this Committee in the United States are demanding attention. It is good to know that most of those who are dealing with them are agreed that, in the future, medical care must be the best that is possible, and at the lowest cost; and that, above all, the freedom of the medical man to act and of the patient to consult whom he likes must be preserved.

OCEANOGRAPHICAL RESULTS OF THE LAST VOYAGE OF THE U.S. NON-MAGNETIC SHIP *CARNEGIE*

THE Carnegie Institution of Washington is issuing a series of reports on the scientific results of the last voyage of the *Carnegie*, and has recently published the first two of the series to deal with physical and chemical oceanography[1]. The voyage was started in May 1928, and was brought to a tragic end after 18 months, when the vessel was destroyed by fire. A general account of the voyage was published by the ship's surgeon in 1932 [2]. One cruise was made in the North Atlantic Ocean, and extensive voyages in the Pacific Ocean, crossing most areas north of 40° S. in the east, and 10° N. in the west.

The publication of both reports has been long delayed. Dr. Sverdrup's chapters on the North Atlantic and Pacific Oceans were written in 1931, and although some revision has been possible, it is not sufficient to take all subsequent work into consideration. The other chapters appear to date from about 1935. While regretting this delay, oceanographers will acknowledge the readiness with which the data have been made available in manuscript form at any time since 1931.

A large section of the physical report deals with the accuracy of the methods of observation. A deep-sea thermometer is suspended fairly rigidly in a stout sealed glass tube which protects it from the effect of pressure. The reading is obtained by arranging to break the mercury thread by making the thermometer turn over in a frame at the required depth. Minor corrections have to be applied, but an analysis of the *Carnegie* measurements indicates that the error in the final reading of a single thermometer was usually considerably less than ±0·045°. By using a pair of thermometers at each depth, the accuracy was increased.

The depth of the observation cannot be assumed to be the same as the length of wire used in lowering the instruments, because surface drift, and possibly undercurrents, make the wire take an appreciable angle from the vertical. The discrepancy is measured by the comparison of readings of two thermometers, one protected against pressure, and the other unprotected and calibrated to show the effect of pressure. A comparison of such measurements with the wire-lengths when the wire was more or less vertical indicated that the thermometer depth measurement was usually reliable to within 1 per cent at 1,000 metres and 0·5 per cent at 5,000 metres. Tables and graphs are given for correcting thermometer readings; but it is believed that they will not be found so generally useful as those by Geissler (1931)[3] and Schumacher (1935)[4], not mentioned in the report.

The *Carnegie* wire soundings were also checked by thermometric depth measurements. Whenever possible the ratio of thermometric depth to length of wire paid out was plotted against the measured angle of the wire at the surface, and the points fall fairly closely about a curve. The depth factor taken from this curve is 0·99 for an angle of 10°, and 0·90 for an angle of 60°. The factors would not necessarily be the same for a different vessel, or one differently manœuvred. The weak point of the *Carnegie* echo-sounder was its timing device, and it has been found necessary to correct the soundings by factors based on the comparison of wire soundings and echo-soundings when they were made close together. When the Fessenden oscillator failed, they used an improvised shot-gun, fired a foot or two below the surface, and made allowance for the greater initial velocity of sound from such an explosive source. It is worth noting that the ultimate standard for the depth measurements was the calibration of the unprotected thermometers, shown to be fairly reliable by the measurements on wires that were nearly vertical.

The analyses of the salinity of sea water were made by measuring the electrical conductivity of samples at carefully controlled temperature. It was a substitution method using water of known salinity. The errors in the determinations proved to be greater than those expected from the titration with silver nitrate, and the electrical method is not likely to replace titration in general use. Minor deviations from the controlled temperature are probably the chief source of error, and they are difficult to avoid.

The second part of the report deals with the information which has been gained from the measurements. One of the most interesting features is a wealth of new information about the deep-water layers in the Pacific Ocean. The measurements confirm that no highly saline water sinks from the surface into the deep layer, and the highest salinities in the deep water are found near the bottom where water of Atlantic and Indian Ocean origin creeps slowly northwards from the Southern Ocean. Compared with the deep-water circulation in the Atlantic Ocean, the Pacific deep-water movements are very sluggish.

The measurements of oxygen, phosphate, silicate and *p*H, described in the report on chemical results, are in close agreement with the conclusions based on temperature and salinity. The concentrations of phosphate and silicate in the deep water are unusually high, and the oxygen contents and *p*H values unusually low, all indicating that the deep water is long removed from the photosynthetic activity of the surface layer, and that there has been time for an abnormal increase in the products of oxidation and decomposition of organic material.

G. E. R. DEACON.

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[1] Scientific Results of Cruise VII of the *Carnegie* during 1928–1929 under Command of Captain J. P. Ault. Oceanography IA: Observations and Results in Physical Oceanography. By H. U. Sverdrup, F. M. Soule, J. A. Fleming and C. C. Ennis. Pp. vii+156. 1.75 dollars. Chemistry 1: Chemical Results of the last Cruise of the *Carnegie*. By Herbert W. Graham and Erik G. Moberg. Pp. vii+58. 1 dollar. (Carnegie Institution of Washington Publications 545 and 562.) (Washington, D.C.: Carnegie Institution, 1944.)

[2] "The Last Cruise of the *Carnegie*". By J. Harland Paul. (Baltimore, Md: Williams and Wilkins Co., 1932.)

[3] "Tiefenmessung mit ungeschutzten Thermometern", by H. Geissler. *Ann. Hydrog. u. Mar. Meteorol.*, 69, xii, 433–438, Plate 45 (1931).

[4] "Kippthermometertafeln neuberechnet auf Grund der Formeln, von W. Hansen". By A. Schumacher. *Ann. Hydrog. u. Mar. Meteorol.*, 63, vi, 237–239, Plates 33–36 (1935).

THATCH GRASS

IMPERATA cylindrica (L.) Beauv., which is a widespread grass of the tropics and sub-tropics, thrives on abandoned or poorly cultivated land. Although it may provide fodder suitable for very primitive types of agriculture, it is undoubtedly a troublesome weed which as the result of present upheavals is likely to become even more of a problem than in the past. For this reason a recent publication solely concerned with this species is particularly appropriate*. The booklet, in which five authors collaborate to cull the available literature, is of considerable interest not merely to the agriculturist but also to everyone at all interested in the grasses.

At the beginning is a chapter by C. E. Hubbard on the taxonomy of the species and its five varieties. His lucid explanation of the synonymy and the position with regard to varieties make delightfully smooth reading of an aspect which must have been difficult both to straighten out and to express so clearly. He admits five varieties, of which *major* (Nees) C.E.H. is the most widespread, being found in South-east Africa and Ceylon as well as throughout India, Malaya, Indo-China, the western Pacific Islands and Australia. The variety *africana* (Anderss) C.E.H. occupies a region in Africa south of the tropic of Cancer; var. *europaea* (Anderss) Asch. & Graeb. is confined to an area round the Mediterranean and eastwards across a strip south of the Caspian to Afghanistan; var. *latifolia* (Hook. f.) C.E.H. occurs only in North India, and var. *condensata* (Steud.) Hack. ex Stuckert is a native of Chile.

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* *Imperata cylindrica*: Taxonomy, Distribution, Economic Significance and Control. Imperial Agric. Bur. Joint Pub. No. 7. Pp. 63. (Imp. Forestry Bureau, Oxford, and Imp. Bureau of Pastures, Aberystwyth.) 2*s*. 6*d*.

Imperata cylindrica ($S=20$) belongs to the tribe *Andropogoneæ*, and Janaki-Ammal has succeeded in obtaining fertile hybrids with *Saccharum*, using, for the ovule parent, plants of the clone P.O.J. 2725 ($S=106$), which itself is derived from the cross *S. officinarum* ($S=80$) × *S. spontaneum* ($S=112$) backcrossed twice with *S. officinarum*.

Unfortunately, the section on the anatomy of *Imperata* falls short of the level of the rest of the work. As it is difficult to convey much information by description alone, there would have been a considerable gain if only a single plate of figures redrawn or copied from the literature could have been substituted for part of the text. Mere descriptions are very inadequate, especially when in a compilation of this sort there seems a tendency to quote authorities just because they have made a statement, regardless of how absurd it may be. For example, what use is there in quoting Duval-Jouve (1875) as saying that round the bundle "There is an inner ring of cells without chloroplasts, the colouring matter being diffused throughout the cell", suggesting that the chlorophyll is either dissolved in the vacuoles or diffused through the cytoplasm? Again, merely saying that in var. *major* "Each vascular bundle of the first order is surrounded with a two-layered bundle sheath, the inner sclerotic, the outer thin walled" might suggest to the uninitiated that *Imperata* should belong to the Pooideæ: a few simple drawings, possibly from Vickery, would have been much more useful than any description.

Although *Imperata* is able to withstand great variation in temperature and will grow up to 2,000 m., and only extreme aridity will prevent it from growing in areas otherwise suitable, it is essentially a tropical or sub-tropical plant. It is light-loving and rapidly colonizes cleared ground or abandoned plantations, spreading profusely by 'seeds' and rhizomes which grow out vigorously from the short basal internodes of the aerial shoots. Its ability to regenerate quickly after firing is one of the factors which make it a menace where primitive shifting cultivation is practised.

Although there are reports of *Imperata* being useful as a nurse crop, it is probably never the best plant for the purpose and is often very harmful later. Again, even if cut continually to encourage a more palatable growth, the general opinion is that it is not a good fodder plant and could probably always be replaced by a better species. (In the chapter on grazing value, an improvement would have been made by stating in Tables 3–5 which are as percentages of dry weight and which as wet weight, and perhaps also, to have included dry-weight percentages in Table 4 for easy comparison with the others.)

After reading the chapters recording the black marks against the species, it is somewhat of a relief to learn that it is apparently the thatch plant *par excellence* and is often cultivated carefully for this purpose alone. No doubt this will lead to a struggle between the various interests in the future.

Its suitability for paper-making is negligible owing to (1) the difficulty of obtaining a product of good colour without excessive bleaching treatment, (2) the short fibre-length, and (3) the impossibility of obtaining sufficiently large and constant supplies of a uniform quality within the economic radius of a mill.

With regard to control, mechanical methods such as ploughing and hoeing are effective especially if persistently employed; but perhaps the line which may be most usefully followed is the exploitation of the plant's intolerance of shade, either by encouraging re-afforestation or by sowing smother crops.

Except for the bibliography, a five-page list of common names in various languages and dialects completes this pleasing little work. If this could be the first of a number of booklets of this type, the others would certainly be at least as welcome, especially at the low price of half-a-crown.

B. C. Sharman.

THE IMPERIAL CANCER RESEARCH FUND

THE forty-second annual report of the Imperial Cancer Research Fund[*] includes an account of progress made in scientific work in the laboratories at Mill Hill.

Mr. H. G. Crabtree has continued his investigations on the effect of substances which retard the carcinogenic action of 3:4-benzpyrene and 1:2:5:6-dibenzanthracene painted on the skin of mice. Bromobenzene and unsaturated dibasic acids, which readily combine with sulphydryl groups, are able to neutralize carcinogenic action. On the other hand, aldehydes, which form unstable derivatives with sulphydryl compounds, have only a slight inhibitory action on carcinogenesis. Another aspect of carcinogenesis, namely, the stimulating effect of wound healing, has been studied by Dr. D. B. Pullinger. She finds that multiple injuries followed by healing may double the incidence of tumours caused by painting with carcinogens. The effect is greatest when the more potent agents are used; with weak or intermediate carcinogens the effect is negligible. The more active carcinogens are presumably able to overcome resistance to the neoplastic change.

The relation of mammary cancer and the milk factor or mammary tumour inciter, present in the tissue of mice belonging to strains susceptible to mammary cancer, has been further investigated by Dr. L. Dmochowski. The factor, derived from any high-cancer strain mice, can induce breast cancer in susceptible strains although their genetic constitution differs from that of the strain from which the milk factor was obtained. Breeding females of low-cancer strain mice do not themselves develop breast cancer even after injection of large doses of the mammary tumour inciter. A proportion, however, of their offspring, both females and œstrone-painted males, develop mammary cancer. The effect of the milk factor was originally shown by foster-nursing young mice immediately after birth. Now, however, tumours have been induced by injecting relatively large doses of material into four-month old mice with well-developed mammary glands. The mammary tumour inciter has no direct influence on the incidence of lung cancer. The sarcomatous transformation of the stroma of cancers is probably independent of the milk factor as it takes place in lung tumours free of mammary tumour inciter. Dr. R. J. Ludford and Miss H. Barlow find that tissue of a lung tumour from a mouse without milk factor is just as active in causing fibroblastic growth in tissue culture as was tissue from similar tumours from mice containing the milk factor.

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[*] Imperial Cancer Research Fund. Forty-second Annual Report 1944–1945. Pp. 32. (London: Royal College of Surgeons.)

FORTHCOMING EVENTS

Saturday, September 15

Conference on "Friedel-Crafts Catalysts and Polymerisation" (in the large Chemistry Theatre, The University, Manchester), at 10.30 a.m. and 2 p.m.

Saturday, September 15—Sunday, September 16

Association of Special Libraries and Information Bureaux (at Portland Hall, Little Titchfield Street, London, W.C.1).—1945 ASLIB Conference.

Saturday, September 15

At 11.45 a.m.—Prof. J. D. Bernal, F.R.S. "Information Service as an Essential Factor in the Progress of Science"; at 2.30 p.m.—Symposium on "Links with the U.S.A.".

Sunday, September 16

At 3.30 p.m.—Discussion on "The Great Book Shortage—its Effect on Education, Research, Empire Intercommunication and the Re-establishment of Cultural Relations in Europe".

Wednesday, September 19

Physical Society, Colour Group (in the Small Physics Lecture Theatre, Imperial College, Imperial Institute Road, London, S.W.7), at 3.30 p.m.—Dr. Dora R. Ilse: "Methods for Investigating Colour Discrimination in Insects" (with colour films and demonstrations).

Friday, September 21

International Society of Leather Trades' Chemists (in the Lecture Theatre of the New Chemistry Building, The University, Leeds), at 2 p.m.—Prof. A. C. Chibnall, F.R.S. "The Contribution of the Analytical Chemist to the Problem of Protein Structure" (Second Procter Memorial Lecture).

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned

Borough Electrical Engineer—The Town Clerk, Town Hall, Barry, Glam. (September 21).

Physicists by firm of Domestic Refrigerator Manufacturers in South Midlands to train for position of responsibility in laboratory testing and research work—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting A.808.XA (September 22).

Civil Engineering Assistant—The Engineer and General Manager, Tees Valley Water Board, Corporation Road, Middlesbrough, endorsed 'Additional Civil Engineering Assistant' (September 24).

Two Supervisors (Production Engineer) for Telegraph Workshops at Calcutta, Jubbulpore and Bombay for manufacture of stores connected with Telecommunication Development—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting C 2484.A (September 28)

Lecturer in Agricultural Chemistry—The Secretary, Edinburgh and East of Scotland College of Agriculture, 13 George Square, Edinburgh 8 (September 29).

Lecturer in Colour Chemistry—The Secretary, Royal Technical College, Glasgow (September 29).

Principal of the Cardiff Technical College—The Director of Education, City Hall, Cardiff (September 29).

Technical and Industrial Assistant in the Industrial Department of the Liverpool Gas Company—The Personnel Superintendent, Radiant House, Bold Street, Liverpool 1 (September 30).

County Analyst—The Clerk of the County Council, County Offices, Preston, Lancs. (October 1).

Electrical Engineer—The Town Clerk, Municipal Buildings, Weymouth, endorsed 'Electrical Engineer' (October 1)

Professor of Bacteriology in the Department of Pathology (Ref. No. F 4802.A), and a Lecturer in Mechanical Engineering (Ref. No. C 2794.A), in the University of Cape Town—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting the appropriate Ref. No. (October 15)

Borough Engineer and Surveyor—The Town Clerk, Town Hall, Watford, Herts, endorsed 'Borough Engineer' (October 15)

George Holt Chair of Pathology—The Registrar, The University, Liverpool (October 31).

Head of the Engineering Department of Bournemouth Municipal College—The Director of Education, Town Hall, Bournemouth.

Graduate Physical Chemists with experience in the Printing Ink or Paint Industry to assist in the investigation of problems connected with the drying of printing inks from the physico-chemical aspect, and an Assistant with experience in scientific and technical abstracting—The Director of Research, Printing and Allied Trades Research Association, Charterhouse Chambers, Charterhouse Square, London, E.C.1.

Administrative Officer—The Secretary, British Scientific Instrument Research Association, 26 Russell Square, London, W.C.1.

Teacher of Building Subjects (Mathematics, Geometry, etc.), and a Teacher of Chemistry (with subsidiary Biology or alternative subject), at the Cambridgeshire Technical College and School of Art—The Chief Education Officer, Shire Hall, Cambridge.

Principal of the Lowestoft Technical Institute—The Chief Education Officer, County Education Department, County Hall, Ipswich.

Lecturer in Engineering Subjects (Mechanical) to Higher National Certificate standard—The Principal, Erith Technical College, Belvedere, Kent.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

A National Basic Outline of Religious Instruction. Prepared by a Committee of Representatives of the Joint Conference of Anglicans and Free Churchmen, the Association of Education Committees, and the National Union of Teachers. Pp. 24. (London: National Union of Teachers, 1945.) 2*d*. [98

Burton-on-Trent Natural History and Archaeological Society. Local Records for 1944. Edited by H. J. Wain. Pp. 16. (Burton-on-Trent: The Museum, 1945.) 1*s*. [98

Medical Research Council: Industrial Health Research Board. Report No. 88: A Study of Women on War Work in Four Factories. By Dr. S. Wyatt assisted by R. Marriott, W. M. Dawson, Norah M. Davis, D. E. R. Hughes and F. G. L. Stock. Pp. 44. 9*d*. net. Conditions for Industrial Health and Efficiency. Pamphlet 3: Why is She Away? the Problem of Sickness among Women in Industry. Pp. 22. 4*d*. net. (London: H.M. Stationery Office, 1945.) [98

Tory Reform Committee. The Charter of the United Nations and the Covenant of the League of Nations: A Comparison by Prof. H. A. Smith. Pp. ii+7. (London: Tory Reform Committee, 1945.) [228

Ministry of Fuel and Power: Committee on the Efficient Use of Fuel. Fuel Efficiency Bulletin No. 41: How to Look After a Boiler Plant. Pp. 10. (London: Ministry of Fuel and Power, 1945.) [228

British Rubber Producers' Research Association. Publication No. 57: The Structure of Polyisoprenes, Part 4, Double Bond Interaction in Certain Carbalkoxy-substituted 1 : 5-Dienes. By L. Bateman and G. A. Jeffrey. Pp. 6. Publication No. 58: The Structure of Polyisoprenes, Part 5, Ultra-Violet Absorption Spectra of certain Carbalkoxy-substituted 1 : 5-Dienes, and the Charge-Resonance Spectra of Glutaconic Ester Enolate Ions. By L. Bateman and H. P. Koch. Pp. 8. Publication No. 59: The Behaviour of Keten towards Olefins and Olefinic Peroxides, by Ralph F. Naylor; Reactivity of Isoprenic and Analogous Hydrocarbons towards Thiocyanic Acid and Dithiocyanogen, by Ralph F. Naylor. Pp. 4. Publication No. 60: The Interaction between Rubber and Liquids, Part 7, The Heats and Entropies of Dilution of Natural Rubber by various Liquids. By Miss J. Ferry, Geoffrey Lee and L. R. G. Thomas. Pp. 12. (London: British Rubber Producers' Research Association, 1945.) [228

Other Countries

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NATURE

No. 3960 SATURDAY, SEPTEMBER 22, 1945 Vol. 156

CONTENTS

Page
Colonial Universities and their Functions . . 345
Some Cambridge Men. By Prof. F. J. M. Stratton . 348
Antigens and Antibodies. By Capt. J. A. R. Miles . 348
Measuring the Infant's Mind. By Dr. John Cohen . 349
Achievement in Medical Science. By Dr. G. Lapage . 350
Pharmacognosy. By Prof. W. O. Howarth . . 350
A Recently Discovered Manuscript by Linnæus. By Dr. Anders Grape 351
Kilimanjaro: Crater Fumaroles of Kibo and Seismic Activity during 1942–45. By J. J. Richard . . 352
Embryology of Angiosperms as a Field for Research. By Dr. P. Maheshwari 354
The Geographer as Humanist. By Prof. W. Fitzgerald 355
Recent Biological Work in Finland. By Dr. G. H. Beale 357

Obituaries :

Dr. J. Davidson. By Dr. W. E. Brenchley . . 359
Mr. R. C. Porter 360
News and Views 360

Letters to the Editors :

Artificial Production of Ergot in the Tropical Plains of Bengal.—J. C. Saha and S. K. Bhattacharjee . 363
B Vitamins in African Fermented Foods.—Dr. Leon Golberg, J. M. Thorp and Sheila Sussman . . 364
Cultures of *Bacterium brunneum*.—William J. Ellis . 365
Unusual State at Birth of a Bat.—T. S. Jones . 365
The Two-body Problem in Milne's Theory of Gravitation.—G. J. Whitrow 365
Effect of the Pressure of Alcohol Vapour on the Operation of the Fast Geiger-Müller Counter. —Dr. G. D. Rochester and C. B. A. McCusker . 366
Flow of Water Through Very Narrow Channels and Attempts to Measure Thermomechanical Effects in Water.—Dr. J. Reekie and J. Aird . 367
Near Ultra-Violet Emission Bands of Benzene.—Prof. R. K. Asundi and M. R. Padhye . . 368
The 'Green Flash' at Sunset with a Near Horizon. —Dr. C. E. P. Brooks 368
Oxidation and Reduction in Chemistry. By Prof. J. Kenner, F.R.S. 369
Gas Research Board 370
Frequency of Earthquakes in California . . . 371
The Stone Age in East Africa. By M. C. Burkitt . 371

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COLONIAL UNIVERSITIES AND THEIR FUNCTIONS*

IN announcing in the House of Commons on July 13, 1943, the appointment of two commissions to report on higher education in the British Colonies, the Secretary of State for the Colonies, Col. Oliver Stanley, said that he regarded educational advance and economic development as the twin pillars upon which any sound scheme of political responsibility must be based. If the goal of Colonial self-government was to be achieved, Colonial universities and colleges would have to play an immense part in that development. They would, first of all, have to meet the enormously increased need for trained professional workers which growing social and economic services would necessitate, providing the agriculturists, the engineers, the medical men, the teachers, the veterinary surgeons, and the specialists and technicians which the approach to higher standards of life entailed. They would be required to carry out an immense amount of research, and, finally, they would have a great extra-mural task of stimulating general progress throughout the areas of which they were centres, and encouraging the production of teachers from those who gain their knowledge and experience from their daily life.

The four reports which have now come from these two Commissions—for the report of Mr. Justice Asquith's Commission is supplemented by a report from the West Indies Committee of that Commission appointed with Sir James Irvine as chairman in January 1944 "to review existing facilities for higher education in the British Colonies in the Caribbean and to make recommendations regarding future university development for those colonies", while that of the Commission on Higher Education in West Africa, reporting under like terms of reference for that area, comprises both a majority report signed by the chairman, the Right Hon. Walter Elliot, and eight of the members, and a minority report signed by Dr. H. J. Channon, Sir Geoffrey Evans, Dr. Julian Huxley, Mr. A. Creech Jones and Dr. Margaret Read—are notable additions to the literature on the idea and purpose of a university. Considering, in accordance with the terms of reference of the Asquith Commission, the principles which should guide the promotion of higher education, learning and research and the development of universities in the Colonies, and exploring the means whereby universities and other appropriate bodies in Great Britain may co-operate with institutions of higher education in the Colonies to give effect to such principles, the Commissions have produced a series of reports in which the functions of a university, the relation between teaching and research, between academic and extra-mural activities are defined with a lucidity and a certainty that make these reports almost as pertinent to discussions on university development in Britain as in the Colonies. No better statement on the place of research could be desired than that to be found in the report of the Asquith Commission, and, quantitatively as well as qualitatively, the reports emphasize the close dependence of Colonial development and expansion in this field on the university expansion already contemplated in Great Britain.

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* Report of the Commission on Higher Education in the Colonies (Cmd 6647.) Pp. 119. (London: H.M. Stationery Office, 1945) 2*s.* net.
Report of the West Indies Committee of the Commission on Higher Education in the Colonies. (Cmd. 6654.) Pp. 81. (London: H.M. Stationery Office, 1945.) 1*s.* 3*d.* net.
Report of the Commission on Higher Education in West Africa. (Cmd. 6655.) Pp. 190. (London. H.M. Stationery Office, 1945.) 3*s.* net.

Naturally, there is much common ground in these reports, and if the principles are dealt with rather more fully in that from the Asquith Commission, it should not be assumed that the same principles are not adequately emphasized in the others. Pointing out first that the four Colonial universities now in existence—the Royal University of Malta, the Hebrew University of Jerusalem, the University of Hong-Kong and the University of Ceylon—serve only a small proportion of those who live in the Colonies, the Asquith Commission bases the case for the establishment of universities in fresh areas on much the same argument as that used by Colonel Oliver Stanley. In the stage preparatory to self-government, universities have an indispensable part to play. To them we must look for the men and women with the standards of public service and capacity for leadership which self-rule requires. It is the university which should offer the best means of counteracting the influence of racial differences and sectional rivalries which impede the formation of political institutions on a national basis. Moreover, universities serve the double purpose of refining and maintaining all that is best in local traditions and cultures; and at the same time they provide a means whereby those brought up under the influence of these traditions and cultures may enter on a footing of equality into the world-community of intellect.

There is, in the Commission's view, no fundamental antithesis between liberal and vocational education, although the distinction has not yet been fully transcended in the universities of Britain. A university is in a far better position than a specialized institution to provide the courses, both in arts and science, which are the necessary preliminary to professional studies; and, while admitting that the promotion of popular instruction is most urgent, the Commission holds that the development of university education is the more imperative on that account, and as the first step urges the immediate setting up of university colleges. Such colleges would later, in accordance with the advice of an inter-university council, develop into universities serving appropriate areas.

The appropriateness of the area to be served by a university should be determined, according to the Asquith Commission, neither by size nor by population, but by the capacity to supply an adequate flow of students able to profit from higher education; and in accordance with this principle the Asquith Commission and the Irvine West Indies Committee specifically recommend the establishment of a University of the West Indies located in Jamaica. The Commission also supports the recommendation for the establishment of a university in Malaya, the proposal to develop Makerere College in East Africa to full university status, and the scheme for the development of Gordon Memorial College, Khartoum. The recommendation of the minority report of the West Africa Commission for the development of a single institution of university rank to serve the whole of British West Africa, entitled the West African University College and located at Ibadan in Nigeria, with a territorial college in each of the three main dependencies, appears to be more in keeping with this principle than that of the majority for the development of three university colleges at Ibadan, at Achimota in the Gold Coast, and at Fourah Bay in Sierra Leone.

Discussing next the range of studies, the Asquith Commission insists in the first place on the importance of a balance between professional and other studies, and accordingly the universities should include teaching in a fairly wide range of subjects. Every student, urges the Commission, should be given an opportunity to become aware of certain great conceptions. He should know something of the place of science in modern civilization and the use of scientific method; he should have learnt something of what is meant by sociology, so that he is aware of the other elements and forms of civilization. He should be enabled to gain some apprehension of what is involved in philosophy in its widest meaning, and some sense of the past as expressed in great literature and in the record of history. If his time at the university does not open his eyes to the existence of those great forces in modern life, the student, however expert in his own work, will have missed one of the great advantages which the university can offer him; here one may well wonder what proportion of students at British universities have really seized the opportunities to which the Asquith Commission points.

This vital principle appears largely to have been overlooked by the majority of the Elliot Commission, though both Commissions recognize the importance of a sound principle: the universities should be residential. Similarly, there is adequate recognition of the importance of providing fully equipped libraries and laboratories, and buildings such as union premises and halls of residence; and questions relating to staff and their environment and conditions of service are discussed with full understanding of the personal issues involved. In particular, the importance of adequate contact with academic life in Great Britain and elsewhere is emphasized and, like the Colonial Research Committee, the Commission fully appreciates the necessity of mitigating the isolation of the teacher or investigator in Colonial universities and colleges. As is pointed out, the whole future of the proposed new universities may depend upon the intellectual standards, wisdom and experience in academic administration of those who mould a college into a university, and carry the university through its first years. At the best, it will not be easy to obtain sufficient men and women of the right quality; and the importance of conditions of leave, of superannuation and secondment as factors in attracting and retaining academic staff of the desired quality is not easily overstressed.

It is clearly to the advantage of the new universities and university colleges proposed in these reports that the fullest contact should be established between them and other centres of research in the territories they will serve. Such contacts will do much, as the Colonial Research Committee has already noted, to counteract the isolation in which research must often be carried on in the Colonies; but the Asquith Commission has rendered a notable service to the establishment of right relations by the clear and emphatic way in which it defines the place of research in the Colonial universities, the field open for such research, and their relations with institutes of applied science. Equally lucid is the chapter in which the Commission develops its argument for an Inter-University Council for Higher Education in the Colonies; that chapter alone leaves no room for doubt as to the help which the universities of Great Britain can render in the developments proposed, and the value of such developments in forging the permanent intellectual links which are so desirable in the world to-day in the interests of peaceful progress.

The Inter-University Council recommended by the Asquith Commission would be a co-operative organization of the universities of Great Britain and the Colonies, charged in general terms with the two distinct tasks of co-operating with existing Colonial universities and of fostering the development of Colonial colleges in their advance to university status. The Commission has not overlooked the work being done in a more general field by the Universities Bureau of the British Empire, but considers a new body would be more appropriate for the discharge of its special function in connexion with the staffing of Colonial university institutions. Here the proposed Council, which would probably carry out much of its work through an executive committee, and would be provided with a permanent secretariat, including a full-time secretary of distinction and experience, and adequate office accommodation, should render considerable service. Other functions of the Council, in addition to acquainting itself with the present position and need of the Colonial universities, would be to facilitate arrangements for such institutions to receive visitors annually, to advise them on any matter of academic policy or research on which they sought its help, to assist the placing of Colonial students in universities in Britain, and to encourage Colonial studies in the home universities and thus stimulate both valuable contributions to the literature on Colonial problems, and an increasing interest in Colonial affairs among their students. The Council would also be available for fostering co-operation with the Dominions or India. But the Commission does not recommend that it should be asked to advise on the allocation to Colonial universities and colleges of grants from United Kingdom funds; for that function an entirely new body, which might be known as the Colonial University Grants Advisory Committee, should be created.

The Commission considers that it is essential that Colonial universities should be autonomous in the sense in which the universities of Great Britain are autonomous; although publication of an annual report, accompanied by a financial statement, and periodical visitation by a properly constituted authority are regarded as reasonable. A constitution is sketched for Colonial universities which offers the autonomy which secures the degree of freedom of teaching and research fundamental to a university, and the Commission examines with some care the period of transition from college to full university status before recommending that for the initial period students should enter for the London external degrees in continuance of the practice followed hitherto in several of the Colonial colleges. Degree-giving powers should be conferred on the Colonial institutions in due course; and the following qualifications are suggested: the staffs must have had adequate experience of work of a university standard; their conditions of work have permitted the active prosecution of research or original work; and a substantial number of students have completed satisfactorily the courses for degrees in a sufficient variety of academic subjects.

Finally, in this first part of its report, the Asquith Commission discusses the thorny problem of entrance qualifications, recommending the passing of a special college entrance examination; the provision of scholarships and financial assistance; the position of Colonial students in Great Britain, on which it recommends the extension of facilities for post-graduate studies, but the limitation of undergraduate study, as the colleges develop, mainly to those students taking exceptional subjects for which there is no local provision; and finance. As regards the last matter, it is considered that the establishment of a university in the West Indies will involve capital expenditure of about £1,130,000 and recurrent annual expenditure of £139,690; some additional funds will also be required by the Imperial College of Tropical Agriculture at Trinidad. Considerable additional funds will be needed by Makerere College in East Africa, and financial assistance in varying degrees may be required in Palestine, by the Royal University of Malta, and in Malaya and Hong Kong. The majority proposals of the Elliot Commission involve capital expenditure of about £1,500,000 and recurrent annual expenditure of about £250,000. The minority report, without entering into detail regarding the financial aspects of its proposals, does not suggest that the capital expenditure involved is likely to be less, but that the elimination of the multiplication of university facilities will result in a somewhat smaller annual expenditure.

Both Commissions recommend that part of the funds available under the Colonial Development and Welfare Act should be specifically assigned to the establishment of universities in the Colonies, and refer to the importance of a stable annual income for orderly development. The Elliot Commission contemplates that ultimately the West African Governments will bear the whole annual cost, and the Asquith Commission points to the desirability of the Colonial institutions building up endowment funds.

(To be continued.)

SOME CAMBRIDGE MEN

Alumni Cantabrigienses

A Biographical List of all known Students, Graduates and Holders of Office at the University of Cambridge from the Earliest Times to 1900. Compiled by Dr. J. A. Venn. Part 2: From 1752 to 1900. Vol. 2: Chalmers—Fytche. Pp. iv+ 594. (Cambridge: At the University Press, 1944.) £7 10*s*. 0*d*. net.

GLANCING through this volume, one gains the impression that the great majority of Cambridge graduates in the late eighteenth and the nineteenth centuries went into the church or into the professions of law and medicine; a smaller number became schoolmasters, entered the army or took up government service at home or abroad. The link between the clerical profession and an active scientific career was closer then than it is now, and it is not without interest that Charles Darwin, the outstanding figure in this volume, went to Cambridge to get a degree as a necessary preliminary to a career in the church. The Darwin family, with William, George, Francis and Horace, provides the best example of the inheritance of scientific power.

One of the most striking groups to be noted is that of the explorers. Doughty of *Arabia Deserta* may be coupled with Drake, the companion of Palmer and Burton. Cheadle with Viscount Milton was an early explorer of western Canada, while Clifton travelled with the Eskimos to the hunting-ground of the musk ox. The latter also broke new ground in Africa, as did Cotterill at Lake Chiassi and Crichton-Browne in Morocco. De Windt in his adventurous travels as a newspaper correspondent gained intimate knowledge of the insides of Siberian prisons. Polar explorers include Ferrar, geologist with Scott, and Fisher, astronomer to Parry on his expedition to find the north-west passage. Of Viscount Melville it is stated that he greatly encouraged Arctic explorations.

Martin Conway and E. A. Fitzgerald provide a link between explorers and climbers. Among the latter we find Cust, who made the first guideless ascent of the Matterhorn, Julius Elliott, also John Ellis, who was in the first ascent of the Finsteraarhorn. Other branches of sport are represented by R. F. and H. L. Doherty, Steve Fairbairn and Henry Foster, father of the seven Fosters of Oxford and Worcestershire. Admiral Fawkes was in a service not frequently claiming Cambridge men until the days of the 'Cambridge Navy' after the War of 1914–18. The Army is much more generally supported, especially through those who fought in that War. William Edwards of Trinity won the V.C. in 1883.

Coleridge, Edward Fitzgerald, Lowes Dickinson and Crabbe stand for literature in this volume. Politicians are numerous: Austen Chamberlain, Harold Cox, with his uncontrollable conscience, Clarkson the abolitionist, and Thomas Creevey of the "Creevey Papers" illustrate a wide diversity of types. Lorimer Fison, student of the Australian aborigines, turns the mind to James Frazer of the "Golden Bough".

The names of professional men of science occur in great numbers: we find two Astronomers Royal in Christie and Dyson, while Fallows was only prevented by an untimely death from being the first H.M. Astronomer at the Cape of Good Hope. The Royal Institution is represented by Humphry Davy, James Dewar and Michael Foster. Of mathematicians we may name Chrystal, Forsyth, W. K. Clifford and Augustus de Morgan. Entomologists include Baron Walsingham, who studied the smallest of moths, and Eltringham. Fitton worthily represents geology, W. R. Fisher Indian forestry, and W. H. Cole the Indian survey. John Elliott organized meteorology in India, other geophysicists being Dines the meteorologist, and Davison the seismologist. William Fairbairn, Dalby and Ewing were notable engineers, the two latter doing valuable work for the Admiralty in the War of 1914–18. Froude, the naval architect, has his name linked with the Froude tank at the National Physical Laboratory. Medicine has many names. Here we mention Walter Fletcher, organizer of the Medical Research Council, and Elliotson, who first used the stethoscope. The latter was of independent mind; he was one of the pioneers in the use of mesmerism, and he was the first to discard the knee breeches and silk stockings worn by his colleagues.

There remain for mention a few who catch the eye by something unusual in their careers. The Rev. W. B. Clarke discovered gold in New South Wales. Dunville was a keen racer in balloons, while Edward D. Clark kept an immense balloon for some days in the hall of Jesus College, finally launching it from the Cloister Court. The thirteenth-century arches in that Court were discovered by Osmond Fisher in 1840 and opened up by him fifty years later. The Hon. Richard Fitzwilliam gave the University the magnificent benefaction of the Fitzwilliam Museum. De Thierry, a French refugee, became an adventurer—"King Charles" of New Zealand. A less reputable adventurer was James Fennell, the actor, "who never paid his bills and passed his life between a palace and a prison". F. J. M. STRATTON.

ANTIGENS AND ANTIBODIES

The Specificity of Serological Reactions

By Dr. Karl Landsteiner. Revised edition. With a Chapter on Molecular Structure and Intermolecular Forces, by Linus Pauling. Pp. xiv+310. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1945.) 28*s*. net.

THE study of serological reactions has for years attracted many workers. There have been fierce controversies between the exponents of differing theories, and these controversies have stimulated both thought and work. During the last thirty years progress has been very rapid, and continues to be so, although relatively little work has been possible in Great Britain during the war years. The production of a revised edition of this extremely valuable book is therefore most welcome.

The new edition is very greatly expanded and almost completely rewritten because of the rapidity of the advances made during the eight years since the previous one. Further, two new chapters have been added; the one on antigen-antibody reactions and the other, written by Linus Pauling, on "Molecular Structure and Intermolecular Forces". In the former there is a historical survey of the theories of antigen-antibody reactions followed by a discussion of those current to-day. In the latter, Dr. Pauling gives a short, clear account of the relation of intermolecular forces to molecular structure which does, however, necessarily assume a considerable preliminary acquaintance with the subject.

Perhaps the most striking of the advances in immunology which have occurred in the last ten years are those, so much dependent on the development and use of electrophoretic technique, which have been made in the study of antibodies. It is interesting to compare the lack of definite knowledge and the contradictory evidence put forward at the time of the last edition with the accumulation of definite knowledge and the promise of continued advance which are so ably recorded in the corresponding chapter of the 1944 edition. In other parts of the subject no new technique of comparable importance to that of electrophoresis has been developed recently, and although numerous and important advances have been made there are not such great changes in outlook and prospects.

The objects of the book are in no way changed. A clear, concise, connected and authoritative account of this expanding subject has been given in a readable form. The bibliography is extensive; more than 2,000 references are given, and the author is more than justified in saying that he has attempted to offer a bibliography comprehensive enough for the use of workers in the field.

Unfortunately, in this edition, possibly to save paper, a system of abbreviations for journals and text-books is used in which, except in one case, a maximum of three letters is allowed. The reviewer has great difficulty in remembering even those initials which occur most often, especially when they bear so little relation to the full title, as 'Pr' for *Proceedings of the Society for Experimental Biology and Medicine*. This type of abbreviation is coming into wider use; but is certainly difficult for the reader and can only be justified as an emergency measure for saving paper.

Dr. Landsteiner and his colleagues have done a very large amount of very important serological work, much of it on antigens and serological reactions using simple compounds. It is fitting that a new edition of "The Specificity of Serological Reactions", prepared shortly before his death and printed posthumously, should be his last published work.

J. A. R. MILES.

MEASURING THE INFANT'S MIND

Intelligence Tests for Young Children

By Prof. C. W. Valentine. Pp. xii+68. (London: Methuen and Co., Ltd., 1945.) 4s. net.

IN this little book, Prof. C. W. Valentine has arranged a series of tests into a scale for assessing the 'intelligence' of children between eighteen months and eight years of age. For backward children the scale is recommended as suitable up to the age of eleven years. Tests are provided at half-yearly intervals up to the age of four, that is, during the period when mental growth is apparently more rapid, and thereafter at yearly intervals. Although the scale is intended chiefly for teachers, it is also meant for the use of that *rara avis*, an 'intelligent parent', eager to weigh the native talent of his offspring.

Apart from four new tests, all the material is borrowed, often with slight modifications, from Burt, Gesell, Stutsman and from the Merrill-Palmer and Terman-Merrill scales. In many cases new age assignments have been given. As in the Binet scale, the tests are scored on a pass-fail principle, and all test items are given equal weight, though no evidence is offered that they deserve it. A practical advantage is the simplicity of the apparatus required.

The reader may be surprised not to find in a book of this kind, where the emphasis is upon intellectual ability, any reference to the work of Dr. Charlotte Bühler, for Dr. Bühler's aim is to judge the degree of maturity attained by the child's personality as a whole, including its cognitive aspects.

A few of the 'tests', for example, bowel and bladder control, are scarcely tests at all in the sense of sampling responses in a standardized situation, for success in them depends on habits acquired under varied conditions of training. Without further evidence, one cannot therefore regard them as indexes of basic ability. The validity of the 'sentence completion' test at age six is also questionable, since it requires the highly specific ability to use two prepositions. One intriguing point is the author's statement (p. 10) that he found a "very close correspondence between very early tests (at only 12 or even 6 months) with tests of intelligence at 10 years and later". One would like to know precisely which tests were given at the age of six months to obtain such good predictions of later ability.

Intelligence testing originated in the practical aim of detecting inferior and superior educable capacity. During the school years the tests can be validated, because an independent criterion of what is measured by the test can be obtained—the teacher's estimates or school marks. In testing pre-school children, however, especially those less than two years of age, no such criteria are available and the question arises: What in fact do the tests measure? Almost certainly it is not just intellectual capacity, as might be the case in later years, but something affected by the child's whole make-up, including sociability, shyness, timidity and the affective dispositions generally. Prof. Valentine is well aware of this. The predictive value of intelligence tests at the early years is low, if only because of the low test reliability at these years; testing young infants is a painstaking task which makes it difficult to obtain consistent results. Although the test stimulus is designed to evoke a cognitive response alone, in reality, the child's entire personality reacts, and this influences the specific response to the test adversely or favourably. It would seem that Prof. Burt's observation made twenty-five years ago is unfortunately still to some extent true: "With infants, indeed, all tests and all estimates are bound to be more or less unsatisfactory" ("Mental and Scholastic Tests", p. 200).

Prof. Valentine admits that the age assignments are not altogether satisfactory, especially in the very early years. Thus the 'action agent' test at age three requires the infant to know the meaning of such words as 'gallops', 'aches', 'explodes', 'roars', etc. This surely deserves a higher age assignment than the Binet test in which the child is required to point to its nose, eyes, mouth, hair and knee, or the one in which the child has to put on his shoes. Some brief experiments by the reviewer confirm this view. Nevertheless, the scale may be warmly recommended for further experimentation and clinical use. It may be justified as a device for roughly gauging the general ability of young children, the estimates improving in accuracy as the child grows older. Much careful work is, however, needed, as the author would doubtless agree, before all the tests could claim a sound theoretical foundation.

JOHN COHEN.

ACHIEVEMENT IN MEDICAL SCIENCE

British Achievement in the Art of Healing

(Achievement Book No. 4.) By John Langdon-Davies. Pp. 36. (London: The Pilot Press, Ltd., 1945.) 2*s*. 6*d*.

THIS publication is one of a series of Achievement Books, the three preceding issues of which record British achievement in art and music, farming and in aircraft. The author of this issue, Mr. Langdon-Davies, pays a richly deserved tribute to modern medical work. "British medical science", he says in his foreword, "is loosely and illogically organized. In spite of this, there can be no doubt that the British medical profession rose to the occasion and solved the problems of war more successfully than they have been solved before in military history. . . ." Some of the problems which faced those others who were charged with medical service at the battle fronts and the means they adopted to meet them are also illustrated in this publication.

Mr. Langdon-Davies has had to contend with the inevitable limitations of space; but his vivid, experienced writing overcomes this difficulty and he is greatly aided by the remarkable photographs of which the publication is largely composed. The very large number of people, medical and non-medical, who contribute essential things to medical work nowadays, is aptly illustrated by the story of what happened to the shattered leg of a soldier in 1915, 1917 and 1940. In 1915 he very often died; in 1917 his life was more often saved, but he remained a cripple for life; in 1940 he was made fit again for duty and he will return to civil life as fit as anybody, even though a limb may have been lost. To this result medical men, scientific men and others all over the world have contributed, and it would be difficult to find a more magnificent example of the co-operation of men of all nations for the common good.

In the succeeding pages Mr. Langdon-Davies takes us through the training of the soldier, describing the improvements in his nutrition and the psychological examinations which improve morale by recognition of the fact that everybody is afraid in battle and by weeding out those whose mental histories predispose them to what used to be called 'shell-shock'. The treatment of shock and of the burns and injuries due to mines which have been so characteristic of this War, the story of blood transfusion and the management of pain and the now well-known histories of the sulphonamide drugs and of penicillin are well told and illustrated by excellent photographs. Plastic surgery, the closed-plaster treatment of injuries, rest and that vital stage in the healing process upon which increasing emphasis is now being laid, namely, rehabilitation, are each briefly described. The subsequent sections on tuberculosis and its detection by mass radiography, on typhus and its control by D.D.T., on malaria and venereal disease introduce us again to civilian life, for these are some of the gravest problems of that war which never ends, the war waged by disease against soldier and civilian alike. The achievement of that 'positive' health which is the subject of the last section is helped by no national mobilization; no Parliament votes fantastic millions to secure it; but to it modern science goes on quietly contributing new weapons which we can use or neglect as we wish. Publications like this should help all those who are trying to remove the suffering and loss caused by disease; for they spread sound knowledge; and knowledge removes the fear, apathy and uninstructed individualism which are among the root causes of so much ill-health and consequent inefficiency and unhappiness all over the world.

G. LAPAGE.

PHARMACOGNOSY

A Textbook of Pharmacognosy

By T. C. Denston. Fourth edition. Pp. xviii+594. (London: Sir Isaac Pitman and Sons, Ltd., 1945.) 27*s*. 6*d*. net.

THIS text-book of pharmacognosy has already found wide recognition among teachers and students of pharmacy. Its subject matter has grown from a laboratory manual intended for use in practical classes, and now comprises the requirements for the Chemist and Druggist Qualifying Examination of the Pharmaceutical Society of Great Britain.

The accounts of the various drugs are systematized and include biological and geographical sources, plant habits, methods adopted in cultivation, collection and preparation for marketing, chief constituents and instructions for practical work. Under the last heading are given schematic descriptions of the drugs and also qualitative chemical tests. The line-drawings are a valuable addition to this section of the work, emphasizing as they do the characters on which recognition is based, and acting as a guide to clear and accurate representation of morphological characters to the student in his own drawing. With the description and the drawings before him, the student can examine a commercial sample of a drug and then proceed to record his own observations.

The organized drugs are classified according to their morphological nature so that they can readily be compared. This is advantageous when points of difference have to be memorized for examination purposes. The drugs of animal origin are grouped together, and the unorganized drugs are arranged according to their similar properties. There is also useful information on drug constituents, stabilization, drying, preservation and adulteration of drugs. The subject matter of this edition has been extended to include the requirements of the addenda to the British Pharmacopœia. Halibut liver oil now receives notice; but the section on the vitamins has been deleted. Mention is made of the effect of war conditions on drug supplies. Additional reproductions of photographs add interest to an already well-illustrated text.

It is unfortunate that considerations of economy have necessitated production on paper of poorer quality than that of previous editions, and that, in spite of this, the price has had to be raised to 27*s*. 6*d*. from 20*s*. These are circumstances over which the author and publishers have no control, and they do not in any way impair the value of the information presented to the reader. The text-book is of convenient size and serves the purpose for which it is intended. It can be confidently recommended to students entering upon the study of pharmacognosy, and particularly to those who are candidates for the chemist and druggist qualification.

W. O. HOWARTH.

A RECENTLY DISCOVERED MANUSCRIPT BY LINNÆUS

By Dr. ANDERS GRAPE
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It is a well-known fact in medico-historical research that the pharmacopœia, which was published in Stockholm in 1775 under the title of "Pharmacopoea Svecica", and at that time received with much enthusiasm both in Sweden and abroad, was prepared with the co-operation of Linnæus himself. The keen interest which the great botanist displayed in the production of a newer work, that might be substituted for the antiquated "Pharmacopœia Holmiensis", published in 1686, was also proved in many ways. (For the last-mentioned work see S. Lindroth in *Lychnos*, 1943, and E. L. Backman in the *Proceedings of the Uppsala Medical Association*, 1923/24.) That Linnæus already in his youth had his attention directed to this subject is shown by a small manuscript, which, like the bulk of his manuscripts left, belongs to the Linnean Society of London, and which just bears the title "Pharmacopoea Holmensis"; and in the correspondence exchanged for many years with his intimate friend, Dr. Abraham Bäck, president of the Collegium Medicum in Stockholm, the question is raised repeatedly from 1749 onward of a fresh and improved pharmacopœia. "You, my friend, who are the only person at the Collegium Medicum, if anything can be done, should touch up the pharmacopoeia", writes Linnæus on October 23, 1749, and a month later Bäck sent a list of the medicines of animal origin in the older pharmacopœia, from which he wishes to delete more than two thirds. After the College some years later (1753), in conformity with a royal decree, had seriously attacked the task of compiling a new "dispensary book", Linnæus probably followed the development of the scheme with constant interest; this is seen *inter alia* from the academic dissertations ventilated during his presidency; for example, "Plantæ officinales" (1753), "Censura medicamentorum simplicium vegetabilium" (of the same year), and several others.

It must, however, be said for the Medical College that serious difficulties arose which prevented a start being made with the work. A circular letter which had been sent to the medical faculties, physicians and apothecaries of the country had certainly caused all sorts of proposals and suggestions to be sent in, and contributions of varying value. These—the greater part of them preserved in MS. No. 151 at the Caroline Institute's Library (Stockholm)—had in their turn been sent to the members of the College; but when the manuscript proper was to be prepared, it consisted of a series of beginnings. In 1755 the various parts were certainly distributed so that each and every one should deal with a certain section, and it was also from the start agreed that in the first instance the British dispensatories, the Pharmacopœia Londinensis and the Pharmacopœia Edinburgensis, were to serve as prototypes. But as easily and often happens, when it is a question of collective work and divided responsibility, none seemed to take the matter seriously—at any rate nobody but the president, Bäck. His admonitory voice was heard time and again at the College, but his appeals to his colleagues were apparently without effect. After eight years had thus passed without the work having advanced, Bäck, in the year 1761, found it necessary himself to undertake the task of drawing up a proposal, which of course was received with approbation by his colleagues. For Bäck, who was very busy, partly as a medical practitioner, partly in his capacity of physician to the royal family, and was forced to stay for lengthy periods at the royal palaces outside Stockholm (Drottningholm, Ulriksdal), the acceptance spelled a serious amount of labour; and it can be understood that for that reason he was forced to seek assistance from his friend, Linnæus. The latter entertained a keen interest in pharmacology, particularly that part of it concerned with simples (simplicia), that is, materia medica; he had published Part 1 of a work dealing with the vegetable substances, and with a certain regularity there occurred a course of lectures on this subject in his academical teaching at Uppsala. At Bäck's request, he has now clearly undertaken to elaborate this part on Bäck's behalf. This is apparent from his letter to the latter, dated November 17, 1761, in which he begs Bäck insistently to procure a royal mandate for the patent of nobility which King Adolf Frederik had promised him, and for his part, he makes the following promise: "I on my part shall do my best that Materia medica will be to your credit and honour". In December of the same year he had sent to Bäck the promised manuscript; for he relates, in a letter of December 22, that he has sacrificed two nights for fair copying, which had therefore been done somewhat hastily, and that in such circumstances a further examination might be found necessary, etc.

As is easily understood, there has been some curiosity regarding the particular nature of Linnæus' manuscript; but it has been generally assumed that it had not only formed the basis for the section on materia medica as this appeared in the completed pharmacopœia when it was eventually published, but also that it was in every particular identical with this version. But there need no longer be any doubt about this point, since I have succeeded in showing that the original manuscript in question is still preserved in perfect condition, although it has hitherto been overlooked by investigators. It consists of 26 foolscap pages, comparatively well written, and is inserted in the previously mentioned volume No. 151 in the library of the Caroline Institute—perhaps the fact that the manuscript happened to be bound up with the previously noticed papers from the early years 1753–54 has contributed to its real nature being overlooked. In this case, too, it is the vegetable substances that are listed. The botanical kingdom quite as a matter of course occupied the foremost place in the heart of 'Princeps Botanicorum'. It should be added, however, that in another manuscript in the same collection (No. 42), there is a sheet in quarto which, in Linnæus' handwriting, contains a fairly hastily made summary of *Animalia* and *Lapidea*, that is, medicines derived from the animal and the rock kingdoms.

It has been possible for me now to show by a detailed comparison with the final version that Linnæus' contribution was not accepted without any further ado, but has been subjected to quite a thorough treatment, including both deletions and additions; but it is impossible to enter upon this matter here in detail. It is not without interest to have been able to ascertain that the revision was carried out by Anders Jahan Retzius, who, in 1769, assisted Bäck in his work on the pharmacopœia—for it was not until that year that the work was finished on Bäck's part. Retzius was eventually appointed professor at the University of Lund, where he carried out pioneer work in several branches of natural history and took the initiative in the foundation of the Royal Physiographical Society; he also founded a family which has produced several prominent natural scientists.

Although the manuscript here mentioned can scarcely be counted as particularly remarkable, the discovery must yet from a Swedish point of view be considered as valuable. For Sweden's national treasure of Linnæan manuscripts was, as is generally known, in the year 1784 so greatly reduced through the indifference of the Swedish authorities and the enthusiasm of James Edward Smith, that every addition is welcomed with satisfaction.

KILIMANJARO: CRATER FUMAROLES OF KIBO AND SEISMIC ACTIVITY DURING 1942-45

By J. J. RICHARD
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IN view of the interest aroused by the activity of Kibo, after several groups of fumaroles had been located in its crater in 1942, it may be useful to give an account on further developments which have taken place on Kibo lately. Full reference to the activity of Kibo's fumaroles in October 1942 and their increased number in February 1943 (see Fig. 2) was made by the writer in a paper on Kibo, past and present, which was sent for publication in July 1943 to the *Journal of the East African Natural History Society*. This paper is as yet unpublished, through printing delays due to the War.

The occasional observations of 1942–43, made in spare time, and the scanty information obtained from the few mountaineers who visited the true crater, were of little value. Only patient observations, requiring time, would permit more precise deductions on events on Kibo. Despite great difficulties attached to regular observations made on a mountain nearly 20,000 ft. high, the indispensable periodical readings of the fumaroles temperatures of Kibo were arranged at the beginning of 1944. I was greatly assisted in this by the honorary secretary of the Mountain Club of East Africa, Mr. J. W. Smethurst of Marangu, who put at my disposal the well-known guide Johane, who accompanied me to Kilimanjaro on several occasions. Johane and an assistant, after having been shown how to take temperatures, ascended Kibo once every month (weather permitting) to record temperatures at five selected spots in the crater. They also checked up the amount of precipitation from four rain-gauges or totalizators installed by me in 1943 on Kilimanjaro, after consultation with Group-Captain A. Walter and suggestions made by Mr. C. Gillman in 1938. These rain-gauges were situated at altitudes of 7,200 ft., 9,400 ft., 12,500 ft. and approximately 16,000 ft. The instrument at 16,000 ft., being unsuited for the collection of snow, was brought down this year at 14,000 ft., on the saddle west of Mawensi, and I took up and installed on March 10, 1945, two snow-gauges at 16,000 ft. and 19,100 ft. for the British East Africa Meteorological Service.

The readings of the temperatures of the five fumaroles mentioned will be extended to nine in future. These five fumaroles were selected, among other reasons, for their positions south, south-east, south and west in different sectors of the crater, rather than for their high temperatures. These regular readings are sufficient to indicate important changes, should these take place. The monthly readings in 1944 give the averages shown in curve *A* of Fig. 3.

The slightly fluctuating curve shows a maximum temperature of 67° C. in February 1944 and a minimum of 47° C. in April 1944, making a difference of 20° C. The variation in temperature between the first and the last month of the readings is 6° C. (lower). When the precipitation figures *B* from the two highest stations—Peters hut, 12,500 ft., and Kibo hut, 16,000 ft.—are examined, it would seem that in the first months, the fumaroles, in other words, the thermic gradient of the volcanic plug of Kibo on the periphery of which (with the exception of fumarole No. 1) the fumaroles are placed, were affected by weather fluctuations. This is most unusual on deep-seated fumaroles as against so-called 'secundary fumaroles' the temperature of which may change very much according to the amount of precipitation. For Kibo, however, this seems disproved by the behaviour of the fumaroles later in the year.

The approximate upper-air temperatures (curve *C*) taken 20,000 ft. above Nairobi on the same dates as the temperatures of the fumaroles are unlikely to have been very much different from those prevalent above Kilimanjaro. They give the same evidence: that the outside influence on the fumarole temperatures is mere coincidence.

The figures obtained from the fumarole temperatures cover too short a period to allow a definite interpretation at this juncture. One has to keep in mind that fluctuations of a still greater order than

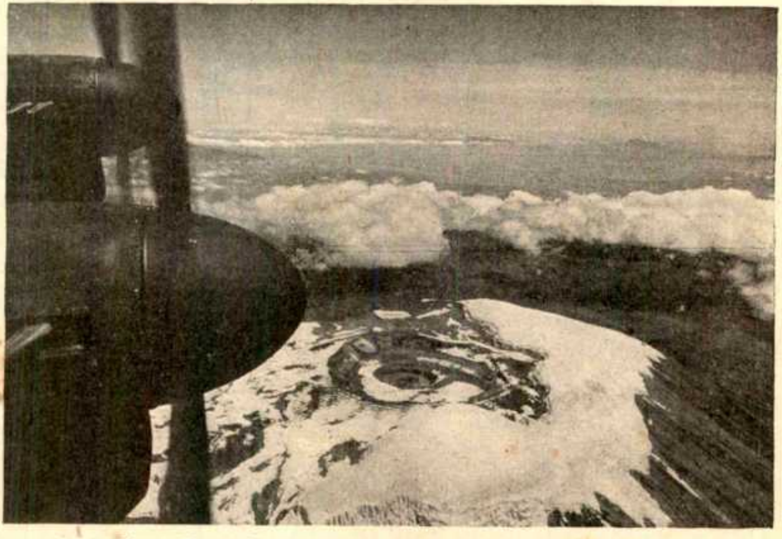


Fig. 1. TOP OF KIBO, CALDEIRA AND NORTHERN CRATER IN 1943.
PHOTO: E. ROBSON, NAIROBI.

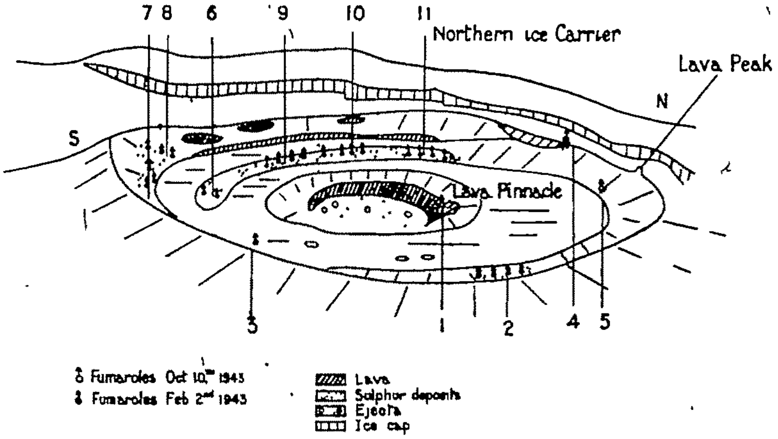
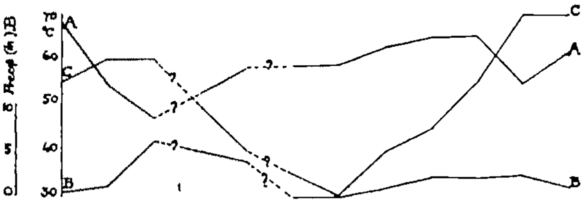


Fig. 2.



	1944 Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan. 1945
Av. temp. (*A*)	68	54	47	—	58	—	59	63	65	65	55	62
Rainfall (*B*)												
Kibo hut	0	0	4·0	1·0		0	0	0·20	0·60	0·50	0·70	0·40
Peters hut	0·40	0·10	6·0	4·0		0	0	1·0	2·30	2·10	2·50	1·40

Fig. 3.

those found in 1944 may have occurred before. We know next to nothing of the behaviour of the crater even since the year 1927, when Dr. R. Reusch first entered it, or in 1930, when Mittelholzer flew over Kibo and published the first photographs of the crater. We have only Tillman's evidence of 1933 of "sulphur fumes discharging from the outer rim on the south side". My personal, general impression on March 10, 1945, was that of a diminution of the activity of Kibo crater since 1942. This is corroborated by the temperature readings in 1942 and in 1945. I recapitulate here some facts, for what they are worth, as evidence for the present:

On October 10, 1942, the temperatures of the eastern fumaroles, No. 2 (absent in June) averaging 91° C., were high. On February 2, 1943, the four points of issue of the fumaroles were much less marked and the fumes replaced by a light screen of water vapour involving only a small part of the slope. The average temperature was only 53° C. during 1944, 52° C., on March 10, 1945.

The south-eastern fumarole, No. 3, showed a temperature of only 37° C. in March 1945, compared with 60° C. in February 1942.

While in February 1943 the upper part of the southern slope was alive with fumes from fumarole groups 6, 7 and 8, there was very little vapour to be seen during March 1945. Temperature, February 1944, 90° C.; March 1945, 71° C.

The western fumaroles Nos. 9–11, when allowing for periodic small fluctuations as mentioned, showed approximately the same temperatures throughout 1944. In March 1945 they were of very similar aspect to that of 1942–43. This is also shown by photographs taken then and now.

Fumaroles 4 and 5 in the northern sector of the crater were in existence in October 1942 and February 1943. Their temperature was not measured, but in 1945 they do not appear to have changed from their behaviour of two years ago.

Spink's paper in the *Geographical Journal* of May 1944 mentions a temperature of 62° C. for the south and an average temperature of only 78° C. for the north-west fumaroles in July 1943.

From written evidence found in the Kibo hut book, I mention that of Lieutenant I. H. Ash, dated October 17, 1943. He "found no cause to put in further pegs to demarcate fresh volcanic activity". "Personally," he wrote, "I should hesitate to say the crater is becoming increasingly active to the point of eruption."

The above data are sufficient to suggest a striking decrease of activity between 1942–43 and 1945.

A fact worth mentioning is the seismic activity reported from Kilimanjaro at the end of 1943 and in the first months of 1944. Two tremors felt at the Kibo hut were recorded by several mountaineers. One, a vertical shock, took place on January 17, 1944 (report by Miss E. Lany). Another fairly strong one in the night of February 21–22 at the Kibo hut (report by Dr. Bucher) was noticed simultaneously at Peters' hut (report by guide Johane). More reports of tremors reached me during the beginning of 1944. Four of these were felt at Mashame, south-west of Kibo. The first occurred in mid-December 1943, the second in the night of January 10–11, 1944, the third in the night of January 28–29, 1944 (reports by Dr. Reusch), and a short tremor was felt at Mashame by Mr. R. Cunningham on April 9, 1944. These tremors were not reported from other localities in the vicinity of Kilimanjaro and were apparently local. At the dates mentioned, only microseisms, varying from extremely slight to slight, were recorded by the seismograph at Entebbe, often at different hours from the Kilimanjaro shocks. The epicentres of the local shocks are unknown, but may well have been on Kilimanjaro itself. This seismic unrest ceased as suddenly as it had started, and no new reports have come in during the last twelve months.

In January 1944 news came through that after the tremor of mid-December 1943 and the one of January 10–11, 1944, one or more long radial crevasses had been seen, from a distance, in the north-west glaciers of Kibo. Longitudinal or radial crevasses, apart from those appearing when a glacier, having been squeezed in a narrow bed, spreads out again, are most unusual. To see what had happened, I undertook an ascent from Mashame, between January 31 and February 4, 1944, along Jeager's route of 1906. A fissure such as reported could only have occurred in conjunction with tilting movements of the strata under the glaciers on the north-west flank of Kibo. During an extensive tour (which will be described elsewhere) nothing of an alarming nature such as disturbances of tectonic or volcanic origin could be detected. A rocky spur newly denuded of ice and snow was, however, apparent. This spur, about 500 yd. long, could easily be mistaken for a fissure in the ice, when seen at a certain angle, from a great distance. It was situated between Drygalski and Credner glaciers to the north of another patch bare of snow, above Penck glacier, where not long ago only a rock appearing through the ice, known in the past as Ravenstein, was in existence. These denudation effects are caused by the increasing rate of the diminution of the glaciers, a well-known phenomenon, as Meyer, Jeager, Klute, Gillman, Geilinger and others have pointed out during the past forty-five years. They are quite natural features in the prevailing climatic circumstances.

Observations on Kibo, both meteorological and volcanological, are continuing, and it is hoped that more data, together with those obtained from other volcanoes in East Africa, will prove useful in the future.

EMBRYOLOGY OF ANGIOSPERMS AS A FIELD FOR RESEARCH*

By Dr. P. MAHESHWARI
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In the history of angiosperm embryology there have been three distinct periods : the first, in which the chief aim was to unravel the chief facts regarding the development of the pollen and embryo sac, and the processes of fertilization and seed formation ; the second, in which interest centred largely round a study of comparative embryology and an evaluation of the data thus obtained for the improvement of the existing systems of classification ; and the third and latest in which embryology has become an experimental subject like cytology and physiology, where one tries to study the optimal conditions for the storage of the pollen and its germination ; the receptivity of the stigma, fertilization and fruit-setting and how far the normal processes of development can be influenced or altered by a change in the environment.

Descriptive Embryology

Most of our facts relating to the course of development of pollen, embryo sac, endosperm and embryo became clear towards the close of the last century through the researches of Amici, Schleiden, Hofmeister, Strasburger, Treub, Guignard, Nawaschin and others, and are now a commonplace in all text-books of botany. Very good summaries of this work were given by Coulter and Chamberlain[1] and Schnarf[2]. Little that is fundamentally new has been discovered during recent years, but there were several errors and misinterpretations made by previous workers which have been corrected and a mass of valuable information added regarding the structure and development of the male gametes, the types of embryo sac development, the process of fertilization, the origin and function of the endosperm haustoria and the development of the embryo[3]. Further work of this type would be welcome ; but results of greater value are to be obtained if attention is now focused on a comparative study of only one aspect of the life-history at a time, namely, male gametophyte, embryo sac, pollen tube, apomixis, polyembryony, the role of the endosperm in embryonal development, etc. Each of these requires the study of a vast amount of literature and often a technique somewhat different from that used for the rest. Finn's work in the Ukraine on the male gametophyte and that of Souèges in France on embryogeny are notable examples of what can be achieved by this method.

Phylogenetic Embryology

In the second period, which may be said to have commenced with the beginning of this century, embryology began to be used as a tool for the improvement of the existing systems of classification, the most important contributions in this line having come from Sweden, Germany, Austria and the United States. A great impetus was given to such studies by the publication of Schnarf's handbook entitled "Vergleichende Embryologie der Angiospermen", in which the author has summarized the existing state of our knowledge of the embryology of each family and added a number of valuable suggestions and comments at the end of each order.

That embryology can be a valuable tool for the systematic botanist may now be considered as established beyond doubt, for if we assume phyletic trends in the external morphology of the flower it is only natural to expect them also in such internal structures as pollen grains, embryo sacs, endosperm and embryo. Indeed, as a very competent embryologist[4] has recently remarked, the resemblances and differences in the embryological characters of the members of a family, although sometimes of such a fine type that they cannot be brought out either in words or in drawings but can only be appreciated under the microscope, are nevertheless of distinct value in delimiting the smaller groups and in determining their interrelationships within each order.

To mention certain specific instances where embryology has rendered an important service in the determination of the proper position of a family, we may first take the Empetraceæ, a family which has been placed by some authors in the Sapindales, by others in the Celastrales and by still others in the Monochlamydeæ. Samuelsson's work[5] has definitely shown, however, that its proper place is with the Bicornes, a group characterized by a number of well-marked embryological features which are also seen in the Empetraceæ : (1) presence of a fibrous layer in the anthers ; (2) presence of a glandular tapetum which does not become amœboid ; (3) pollen grains remaining together in tetrads ; (4) ovule with single integument and an ephemeral nucellus which disappears in later stages so that the embryo sac lies in direct contact with the integumentary tapetum ; (5) absence of parietal cells in the ovule ; (6) embryo sac of the monosporic eight-nucleate type with small ephemeral antipodals ; (7) a fluted hollow style which connects the lumen of the ovary with the outside and along which the pollen tubes make their way into the ovary ; (8) a cellular endosperm, with the first two divisions transverse and giving rise to a row of four cells placed one above the other ; (9) the formation of endosperm haustoria at both ends of the embryo sac, micropylar as well as chalazal ; (10) a single-layered seed-coat formed from the outermost layer of the integument, the remaining layers becoming absorbed during the growth of the embryo sac and embryo. There is no doubt that Samuelsson established his point of view fully and completely, and Hutchinson's[6] assignment of the Empetraceæ to the Celastrales is incorrect.

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* Abridged and modified from the presidential address delivered to the Indian Botanical Society, January 1945.

Without going into details it may be further mentioned that on embryological and perhaps on other grounds as well the Lennoaceæ, which have sometimes been placed in the Bicornes[6], should be removed to the Tubiflorales[7], the Cactaceæ are best classed under the Centrospermales[8], the Podostomaceæ and Hydrostachyaceæ under the Rosales[9], the Moringaceæ under the Rhœadales[10] and the genus *Trapa* in the family Hydrocaryaceæ apart from the Onagraceæ. Recently, Schnarf[11] and Wunderlich[12] have suggested a number of rearrangements of the tribes and subtribes within the family Liliaceæ, which deserve the notice of the taxonomist. Space forbids a reference to several other works of a similar nature.

What has been written above is enough to show that with the main lines of latitude and longitude chalked out by the systematist it is possible for the embryologist, in co-operation with the cytologist and anatomist, to use this as a background and to help him in his work. Once a group has been assigned to its true place, every character that is studied will only serve to strengthen its position. On the other hand, if there are any discrepancies, they will be brought out in a more glaring fashion by the study of its internal characters (as these are less influenced by the environment) than the external.

There is great scope for phylogenetic embryology, as there are several families which have so far received little or no attention from this point of view. Special mention may be made of the following: Casuarinaceæ, Garryaceæ, Loranthaceæ, Balanophoraceæ, Aristolochiaceæ, Nymphæaceæ, Ceratophyllaceæ, Berberidaceæ, Magnoliaceæ, Myristicaceæ, Fumariaceæ, Droseraceæ, Zygophyllaceæ, Simarubaceæ, Callitrichaceæ, Burseraceæ, Hippocrateaceæ, Bombacaceæ, Sterculiaceæ, Salvadoraceæ, Dilleniaceæ, Dipterocarpaceæ, Flacourtiaceæ, Cornaceæ, Ebenaceæ, Myrsinaceæ, Pandanaceæ, Najadaceæ, Cyperaceæ, Palmaceæ, Cyclanthaceæ, Lemnaceæ, Flagellariaceæ, Xyridaceæ, Eriocaulaceæ, Stemonaceæ, Hæmodoraceæ, Dioscoreaceæ, Zingiberaceæ, Marantaceæ, Triuridaceæ and others. It is quite possible that a detailed knowledge of the embryology and internal structure of these families will in some cases give a new orientation to our ideas of their relationships.

Applied and Experimental Embryology

Coming now to the comparatively new field of experimental embryology, we find that the main directions in which work is being undertaken are: a study of the viability of the pollen and the optimum conditions for its storage and germination; the receptivity of the stigma; the rate of pollen tube growth under different conditions of temperature and humidity; the influence of external conditions on the interval elapsing between pollination and fertilization; the influence of X-rays, heat and chemicals upon the normal course of development; the induction of artificial parthenogenesis and parthenocarpy; and the culture of excised embryos *in vitro*. Considerable work on these lines is being done in the United States and the U.S.S.R. regarding the immense value of which in our breeding programmes there can be no question. We may hopefully envisage the possibility of having one or more 'pollen banks' in each country, where pollen of almost every plant of economic value will be stored under optimum conditions and supplied to recognized workers *gratis* or on a moderate charge. We shall be able to control sterility and unfruitfulness caused by premature or delayed pollination, a slow growth of the pollen tube or other similar causes. The culture of excised embryos under aseptic conditions has been of great help in overcoming the sterility which is inherent in certain interspecific hybrids as shown by the abortion of the embryos at an early stage of development if allowed to remain inside the ovule. This has given a new hope to the plant breeder for the creation and full development of many forms which were genetically possible but unobtainable due to other reasons.

Summing up, the embryology of angiosperms offers abundant scope for research not only on the descriptive side, which has not yet been exhausted, but also for the solution of many vexed phylogenetic problems and as an aid to the work of the plant breeder. In this last respect it comes in close contact with cytology and physiology and promises to be a study of great importance in the near future.

[1] Coulter, J. M., and Chamberlain, C. J., "Morphology of Angiosperms" (New York, 1903).

[2] Schnarf, K., "Embryologie der Angiospermen" (Berlin, 1929).

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THE GEOGRAPHER AS HUMANIST

By Prof. W. FITZGERALD
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It is no longer possible, as in earlier days, for the individual researcher to investigate with equal facility all aspects of geography. Inevitably, as in other expanding branches of learning, there is concentration of effort in specialized directions, involving the inevitable risk that the essential unity of the subject and the effective inter-relations of its parts may be impaired. The complete geographer, like the complete historian, does not exist; though many a geographer of the generation which is now passing, by reason of his supposed range of interests, has been expected to qualify for the role.

Three recent papers in *Nature*[1], devoted to the purpose and method of geographical investigation, included particular reference to political geography, because of its special significance in a period of international crisis and widespread frontier changes. The political and the economic are the two humanistic aspects of geography which have most attracted attention, though there has been diffidence on the part of those concerned in providing a thorough-going presentation of the principles on which investigations have been made. If, however, the elucidation of political geography on its philosophical side is still without its proper place in the literature of the subject, what is to be said regarding the position of social geography, for which no statement of concepts of acknowledged orthodoxy exists! It is not surprising that confusion in teaching results, and that the social aspect of geography is occasionally identified with social anthropology which, in one guise or another, has sometimes been taught as 'human' geography.

Like every aspect of the subject, the physical as well as the humanistic, social geography is concerned with the spatial arrangement or pattern over the world of certain phenomena—in this case the phenomena which are of social, as distinct from political and economic, significance to man. They are treated, not in isolation, but in their interacting relationships with the total environment of man—an environment subject to, and undergoing constant transformation. Environment comprises not only the pattern of terrestrial phenomena within the habitat of man, in so far as they remain unaffected by human agency, but also the 'cultural landscape' which man has fashioned, with or without a plan, during his occupation. We think, for example, of the almost complete removal of the original forest-cover of western Europe in fairly recent historic time, and of ensuing agricultural and industrial utilization. Debate may long continue regarding the extent to which man, in his planned utilization of land, is subject to geographical controls: but it is generally accepted that his initiative is permitted adequate scope within the range of possibilities available at a given time. So much is agreed, even by those who contend that, in the realm of thought, man has the power to liberate himself from restrictions imposed by environment.

The most obvious transformation of environment by human agency is that which results from exploitation of economic resources. Less obviously and directly, environment is transformed in response to the application of political ideas. Political geography is dependent, in large measure, on the readiness of communities to seek economic, social and political segregation by raising frontiers against each other. A world without such frontiers seems at present unattainable, though rather because of the conscious rejection of federation as a way of political life than because of insurmountable geographical barriers. Apart from the study of all that is involved in the alignment of frontiers, the political geographer considers the effects of the political partition of territory on the life of the communities concerned. The selection of the site of a national capital, the geographical pattern of a national network of communications—these are two obvious examples of response, exemplified in every country, to the geographical limitations and opportunities imposed or offered by existing frontiers.

The manifestations of social life which contribute to the sum-total of human environment include, *inter alia*, the geographical distribution of population and of urban and rural settlements. In every continent, population is becoming more and more concentrated in large towns, with revolutionary consequences for social life. This is as true of oriental as of occidental civilization, as trends in urban growth in Britain, the United States of America, the Soviet Union, and Japan illustrate particularly well. The study of towns from the point of view of social geography is still in its infancy in Britain. It is but one aspect of an investigation which embraces the characteristics and relationships of all types of settlement, ranging from the city to the hamlet. In view of the present urgency of regional and town planning, it is not surprising that the geographer has received during the War a degree of official recognition unknown before. In his approach to the study of settlements, he recognizes that they are subject to an endless process of change, which may be one of either growth or decay according to trends prevailing within the region concerned. It is the dynamic quality in social, as in other aspects of geography, which most strongly appeals to the student of contemporary affairs.

Inseparable from the study of settlements is the geographical pattern of population distribution. It exerts a powerful influence upon the structure and organization of society, and provides the geographer with impressive, though not always conclusive, evidence of the comparative advantages for human occupation offered by the various regions of the world. Unfortunately, man is not free to settle the areas which are both geographically accessible and well-endowed by Nature. Political and social impediments, such as restrictive immigration laws, exist to arrest a natural tendency to migration from congested to emptier lands available for settlement. How to ensure that the population of a given area shall be, in density, neither excessive nor inadequate, taking into account both existing resources and their intended use, is the question on the answer to which social and economic planning largely depends. Such demographic terms as 'low' and 'high density' are frequently employed without reference either to prevailing social and economic standards or to comparative densities in other parts of the world, where similar geographical conditions prevail. There is obviously little value, from the geographical point of view, in comparisons of population density between communities of widely different social experience and habitat. A degree of density which is accepted as high for tropical Africa would be low according to Western European standards, even when comparison is restricted to non-industrialized areas of both zones. The fast-increasing 'urbanization' of population in every continent might suggest an approach to ultimate demographic uniformity throughout the entire world: but contrasts in population density between one region and another are assured for all time, if only because of wide variation between regions in regard to the economic possibilities that exist.

So far our reference to social geography as omitted the interaction between environment and manifestations of social intercourse, such as language and religion. To what extent do the geographical conditions of man's habitat intervene to affect the shape of human relationships? The fashion, not unknown among sociologists and economists, of studying society as if it existed in a geographical vacuum, is passing. Increasingly it is recognized that it is impossible to approach the study of society without reference to the territory on which its existence depends and with the horizons of which its traditions are harmonized.

Investigation of the inter-relations of the members of such comparatively primitive societies as the hunting-groups of Africa or the nomadic pastoralists of the steppes has usually welcomed the contribution of the geographer. It is quite unnecessary, however, for the latter to devote over much attention to the traditional social pattern of such peoples, in view of the rapidity with which, under pressure of new impacts, their social and economic experience is being transformed. It is now difficult to point to any part of the world where the life of primitives has not been revolutionized within the last half-century, through contact with peoples of contrasted, and generally superior, social and economic *techniques*.

Until recently, the Tatar-Mongols had maintained, almost unchanged for countless generations, their traditional social standards. Life had become stereotyped in its association with a grassland environment, which had known no important change throughout human time, save fluctuations in the abundance of natural pasture. The pastoral societies which, some decades ago, the French geographer, Demolins[2], described as peoples "without a history" have, in our time, grown accustomed to the complex social conditions of newly industrialized cities, such as Tashkent and Stalingrad. The modern civilization of the Euro-Asiatic steppe provides a particularly vivid example of the power of geographically mobile ideas to transform, by planned selection of available possibilities, an environment hitherto regarded as hostile to, and immune from, change.

The geographer recognizes that social organization, in so far as it is affected by geography, is a response, not only to local environmental conditions, but also to the degree of intimacy which exists between one region and another. Prof. Schrader's Herbertson Memorial lecture[3] of 1919 discussed the imperative need for the establishment of equilibrium between environment and society, and pointed to the temporary absence of such equilibrium over large parts of the continents as the principal cause of the world-wide social and political unrest of his time.

Search for evidence of the influence of environment on religion and language has had its appeal for one school of social geography. An earlier generation of environmentalists went so far as to advance geographical determinism in explanation of the Middle East zones of origin of the three great monotheisms —Christianity, Judaism and Islam. These religions, regarded as 'products' of a desert or semi-desert environment in each case, could not have arisen—according to the argument—under any other geographical conditions. Many, shocked by such doctrine, were yet prepared to admit that religious beliefs and practices are incomprehensible without reference to the social experience of the founder of the faith : which would seem to go half-way to the deterministic conclusion. Certainly each body of religious practices grows in association with a particular environmental setting, as George Adam Smith's classical work[4] offers impressive evidence. Moreover, when religious concepts spread from one region to another where social conditions are markedly different, they are inevitably modified in the process. Every religion of wide geographical range comprises, within its zone of influence, a diversity of concepts and practices which is intimately associated with the regional experience of its adherents.

Mere description of the distribution of religions and languages in terms of nations or political divisions is, in itself, a sterile enterprise. On the other hand, why their influence extends in certain geographical directions and not in others, why in certain areas they remain relatively 'pure' whereas in others they become 'mixed'—these are questions to the solution of which the geographer may be able to contribute from his knowledge of inter-regional associations. In these and other such inquiries it is the geographer's duty to ensure that the relationship of society with environment is not overlooked. Whether or not, on this basis, modern scholarship would concede the geographer's qualifications as a humanist, it should not be forgotten that by the Greeks of classical times he was accepted as such.

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RECENT BIOLOGICAL WORK IN FINLAND

By Dr. G. H. BEALE
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DURING the War readers of *Nature* will have had little or no access to Finnish scientific publications ; nor under present conditions is it to be expected that there will be a rapid resumption of the exchange of periodicals in Europe. Consequently it is hoped that the following brief summary of recent Finnish biological work will be of value. A large quantity of material was kindly supplied to the author by Profs. R. Collander, H. Klingstedt and others. Space will not permit of the reproduction of more than a small proportion of this material ; in particular, records of applied work have been omitted, and of the mass of descriptive studies, only the most cursory mention can be made.

Finland is one of the few countries in Europe in which the vegetation over large areas has been comparatively little disturbed by agriculture or urban development. It therefore affords suitable terrain for the study of plant ecology and plant geography, and in fact a large number of papers have appeared on these subjects in recent years. Taxonomy also claims considerable attention in Finland, owing to the strong Linnæan tradition. Progress in other branches, however, may be attributed to the enthusiasm of certain individual workers ; for example, there is the plant physiological work on permeability at the Botanical Institute, Helsinki, under the direction of Prof. R. Collander, the biochemical work on nitrogen fixation in Prof. A. I. Virtanen's department[1], the cytological work in Prof. H. Federley's Genetical Institute, the animal physiological work under the direction of Prof. Paavo Suomalainen, and Prof. Pontus Palmgren's well-known ornithological studies. All these departments have been able to continue their work to some extent during the war years, though the Botanical Institute in Helsinki has suffered some bomb damage.

Plant Physiology

The plant physiological work of Prof. Collander's department is at present mainly concerned with two problems : (*a*) quantitative determinations of the permeability of plant protoplasts to dissolved substances, and (*b*) the active uptake of mineral salts by plant cells. V. Wartiovaara[2] has studied the effect of temperature on the rate with which eight different non-electrolytes exosmose from the giant cells of *Tolypellopsis stelligera* (Characeæ). He found a pronounced effect of temperature on the rate of permeation of these substances, the Q 10 being between 2·5 and 5·5 except for hexamethylene tetramine, where it was as high as 9. The temperature coefficients were found to be independent of lipoid solubility and permeation power of the substance used; but substances with smaller molecules, such as urea, ethylene glycol, urethylan, had lower Q 10's than substances with larger molecules.

Wartiovaara[3] has also studied the permeability of cells of *Tolypellopsis* to heavy water and methyl alcohol. These substances were found to permeate at approximately the same rate, and about two hundred times as fast as urea or twenty thousand times as fast as glycerol. It was also found that methyl alcohol permeates about ten times faster than substances of approximately the same relative lipoid solubility but greater molecular size, while heavy water permeates several hundred times faster than substances of corresponding lipoid solubility but greater molecular size. Molecular size is therefore a very important factor in permeation power in the case of extremely small molecules.

R. Collander, H. Lönegren and E. Arhimo[4] have found that neutral red, a rapidly permeating basic dye, permeates into the epidermal cells of *Allium* approximately twenty thousand times faster than urea, a non-electrolyte, in spite of the greater size of the neutral red molecules.

Collander[5] has also been investigating the selective absorption of various cations by higher plants, by growing some twenty species of phanerogams in nutrient solutions containing several cations in equivalent amounts, and afterwards determining the cation composition of the plants by Lundegardh's method of quantitative spectral analysis. It was found that rubidium and cæsium were taken up in approximately the same amounts as potassium; similarly strontium was taken up in the same amount as calcium. Thus the plants were unable to distinguish between potassium, rubidium and cæsium, or between calcium and strontium.

Collander[6] has also studied the distribution of several cations between root and shoot, and found that some cations (potassium, rubidium, cæsium) are approximately uniformly distributed; but that sodium and manganese in most species occur in higher concentrations in the root, and calcium, strontium and lithium in the aerial parts of the plant.

Animal Physiology and Developmental Mechanics

Paavo Suomalainen[7] has continued his investigations into the physiology of hibernation in hedgehogs. Arising out of the results reported in *Nature* in 1939, when he showed that hibernation could be artificially induced by injecting hedgehogs with insulin and putting them in the cold, Suomalainen has now found that the islands of Langerhans in the pancreas are hypertrophied during hibernation. He has also discovered that adrenalin secretion is much decreased during hibernation.

Osmo Tuurala[8] has been studying the movement of the pigments in the eyes of various Lepidoptera, which can be classified into at least five types according to their behaviour in this respect. In types considered to be primitive there is movement only of the iris pigment, while in more advanced types there is movement of other pigments also, namely, the retinula pigment, the pigment of the basal cell of the retinula (this moves in the opposite direction to the other pigments), and finally of the cell nuclei themselves. The primitive type is found only among night-flying Lepidoptera; dusk- and day-flying insects have the more advanced types.

Sykkö Pesonen[9], studying the nutrition of the hedgehog embryo, has found that during pregnancy, the corpus luteum secretes a hormone which is essential for the histiotrophic type of nutrition. This has been confirmed in mice also, by Annikki Vaalanto (unpublished).

Sulo Toivonen[10] has been investigating the *specific* induction effects obtained by implanting into newt gastrulæ small pieces of tissue from an unrelated species. Thus liver tissue from perch, guinea pig or viper (previously killed by treatment with alcohol) induced almost exclusively organs belonging to the anterior part of the head (anterior brain, nose, eyes, balancer). Kidney tissue from perch and guinea pig induced organs which in normal development occur in the posterior part of the body, from the ears backwards, especially secondary tails. Bird and viper kidney tissue, however, induced organs normally found in the posterior part of the head, that is, mid brain and posterior brain. Thymus gland tissue from the guinea pig often induced eye-lenses, a highly specific effect.

In a later publication, Toivonen[11] has reported on experiments with thymus gland tissue from guinea pigs of different ages, from which it is seen that the lens-producing substance predominates in four-months old thymus (or slightly younger), while in older glands the relative quantities of other substances increase.

Cytology and Genetics

Esko Suomalainen[12,13] has been continuing his study of the interrelation between parthenogenesis and polyploidy in the Otiorrhynchinæ and Brachyderinæ (weevils), and Blattoideæ (cockroaches). He has found that of the nine Finnish parthenogenetic weevils, there are one diploid, five triploid and three tetraploid species; while the bisexual species are all diploid ($2n = 22$). Suomalainen also reports a curious *gonomery* in the ripe eggs of some parthenogenetic species of weevil; for example, in a tetraploid species the different sets of chromosomes sometimes remain in separate groups—11 in one plane, 22 in another, 11 in a third; or 33 in one plane and 11 in another, etc.

Tarvo Oksala[14], studying meiosis in eight species of the dragon-fly *Aeschna*, has found that at spermatogenesis each bivalent normally contains one fully terminalized chiasma, while at oogenesis there are two chiasmata per bivalent, at opposite ends. There is a single X-chromosome in the male, which is sometimes attached to one of the autosomes, and always divides at the first meiotic division; a chiasma is never formed between the X and the medially situated centromere. On the basis of these studies, Oksala puts forward the unorthodox view that the first maturation division is an 'equational' one, at which the centromeres divide.

Prof. H. Federley[15], carrying on his long-continued cytogenetic researches on species and race hybrids in the Lepidoptera, has reported an unexpected chromosome situation in the hybrid between the European *Dicranura vinula* ($n = 21$) and the African *D. delavoiei* ($n = 31$). Both at spermatogenesis and oogenesis, at the first and second meiotic metaphases, only twenty-one (or sometimes a few more) chromosome 'units' are seen. In other hybrids in the same genus the number of chromosomes approaches the sum of the haploid numbers of the parents, since pairing at meiosis is very weak. Federley[16] has discovered a natural population of *Pygœra pygra* in which spermatocytes with the diploid number of chromosomes occur frequently. He is also preparing a general survey of chromosome numbers in the Lepidoptera.

E. Pfaler-Collander[17] has made a comprehensive cytological study of forty-five species of bugs of the family Lygæidæ and includes in her paper the novel feature of a key for the determination of the species by means of the numbers and relative sizes of the chromosomes.

Esko Suomalainen (unpublished) has made some observations on the inheritance of aneury in cats. He finds that it is due to a single gene, lethal when homozygous.

General

Space does not allow any account of the numerous publications on plant taxonomy, geography and ecology which have appeared in Finland during the War. Taxonomists will, however, be interested to learn of the completion of the monumental "Plantae Finlandiae exsiccatae a Museo botanico Universitatis Helsingforsiensis", by Harald Lindberg, which now comprises no fewer than 1,457 species. G. Marklund[18] has continued his investigations into such apomictic groups as *Taraxacum*, adding some thirty-two new Finnish species to those already known, making more than two hundred in all, and *Ranunculus auricomus*—*R. cassubius*, of which several tens of micro-species occur in Finland.

During the War more than eighteen papers on plant ecology or geography have appeared. Among them may be mentioned I. Hustich's work on the influence of climate on the forest limit, a subject of obvious importance in a country in which timber is of such enormous economic significance.

Prof. Pontus Palmgren and his collaborators have been carrying on their extremely careful and patient observations on the behaviour of birds. Among other studies, Palmgren[19] has investigated the day-and-night rhythm of migratory birds (for example, robins and thrushes) in captivity. He has found that during the winter and summer, the birds move about during the morning and evening ; while in the spring and autumn (the migration seasons), they move about at night. (Migration takes place at night.) Palmgren also has noticed individual peculiarities of each bird, which remain very constant.

Prof. O. Kalela[20,21] has been continuing his studies on population dynamics of mammals (such as lemmings) and birds (such as grouse).

Finally, some interesting work on insect ecology, inspired by the pioneer investigations of R. Krogerus, is in progress. Such, for example, is E. Palmen's study of the immense clouds of insects, containing some quite foreign species, which from time to time drift over the coast of Finland.

In conclusion, it is with regret that one must record the deaths of F. Elfving (1854–1942), who was for so long head of the Botanical Institute of the University of Helsinki and was the first plant physiologist in Finland ; K. Linkola (1888–1942), well known for his work on the influence of culture on the vegetation and flora of the district north of Lake Ladoga ; and A. K. Cajander (1879–1943), author of the theory of forest types.

[1] *Nature*, **155**, 747 (1945).
[2] *Ann. Bot. Soc. Zool.-Bot. Vanamo*, **16** (1942).
[3] *Acta Bot.*, **34** (1944).
[4] *Protoplasma*, **37** (1943).
[5] *Plant Physiology*, **16** (1941).
[6] *Acta Bot.*, **29** (1941).
[7] *Proc. Acad. Sci.*, **4** (1943).
[8] *Ann. Entomol.*, **11** (1945).
[9] *Ann. Zool. Soc. Zool.-Bot. Vanamo*, **9** (1942).
[10] *Ann. Acad. Sci.*, Ser. A, **55** (1940).
[11] *Ann. Zool. Soc. Zool.-Bot. Vanamo*, **21** (1945).
[12] *Ann. Acad. Sci.*, Ser. A, **54** (1940).
[13] *Hereditas*, **31** (1945).
[14] *Ann. Acad. Sci.*, Ser. A iv, **4** (1943) ; also unpublished.
[15] *Hereditas*, **29** (1943).
[16] *Acta Zool.*, **35** (1942).
[17] *Acta Zool*, **30** (1941).
[18] *Acta Bot.*, **26** (1940).
[19] *Zeits. Tierpsychologie*, **6** (1944).
[20] *Ann. Zool. Soc. Zool.-Bot. Vanamo*, **8** (1941).
[21] *Ornis*, **21** (1944).

OBITUARIES

Dr. J. Davidson

THE unexpected death of Dr. J. Davidson, at the age of sixty, came as a shock to his many associates in Great Britain and in Australia.

Davidson graduated from the University of Liverpool in 1908, taking his D.Sc. degree in 1915. He worked as a research scholar at the Imperial College of Science and Technology, London, and with the Ministry of Agriculture, his work also taking him abroad to Paris, Berlin and Florence. He served during the War of 1914–18 as captain in the R.A.M.C., carrying on special entomological work particularly on the relations between mosquitoes and malaria. His work in Sinai was mentioned in dispatches.

In 1920, Davidson joined the staff of the Rothamsted Experimental Station in the newly formed Entomological Department under A. D. Imms. His work was concentrated on the biology of the bean aphis, *Aphis rumicis*, and he also collaborated with H. Henson in studying the effect of various chemical substances on aphis infestation. The materials were either injected or watered on to the sand in which the plants were grown, pyridine proving fatal to the aphids at strengths which were harmless to the plants. Observations in the course of this investigation led to the intensive work on the relation between boron and plants later carried out in the Botanical Department of Rothamsted. Besides numerous papers on the subject, Davidson published in 1925 an important monograph listing the British aphids.

In 1928, Davidson accepted the post of entomologist to the Waite Research Institute at Adelaide, Australia, and soon after was also appointed as professor of entomology at the University of Adelaide, holding both posts until his death. His Australian work again took a very practical bias, and during his first few years in the country, he dealt with a number of insect pests which were the cause of considerable economic loss. Thrips, Collembola, 'white grubs' (larvæ of beetles of the family Scarabæidea), eelworms, and other pests attacking pastures, cereals and fruit came under investigation, and control measures were suggested. Later he gave considerable attention to locust and grasshopper outbreaks, arising from a widespread plague of grasshoppers in South Australia during 1933–35. This led to more generalized work on the ecology of insects, particularly in relation to climatic conditions, most of his later papers dealing with various aspects of this subject.

Soon after taking up work at Rothamsted, Davidson married Johanne Therese Hornemann, one of a very musical Copenhagen family. Three sons went out with them to Australia, a girl being born later. Their musical evenings at Harpenden will long be remembered by those who were fortunate enough to be invited. W. E. BRENCHLEY.

Mr. R. C. Porter

MR. RALPH CLASSON PORTER, for thirty-seven years senior lecturer in the Department of Mechanical Engineering, University of Birmingham, died at his home in Northfield on July 28, in his seventy-fourth year.

Mr. Porter was the son of the Rev. James Nixon Porter and was born at Heatley, Warrington, on August 14, 1871. He was educated at Clifton, and afterwards at the University of Liverpool, where he obtained a first class honours degree in engineering in 1892. After graduation he was for three years a premium pupil with Messrs. Beyer, Peacock & Co., Ltd., of Gorton, Manchester, and on completion of his pupillage spent a short time with the Belfast and Northern Counties Railway, obtaining running experience on the footplate. His enthusiasm for locomotives and locomotive engineering was to remain with him throughout his lifetime. For nearly four years after leaving the railway he was assistant manager of the rolling mills of the Frodingham Iron and Steel Company.

In 1899 Mr. Porter took up academic work and was appointed lecturer in engineering at the Polytechnic School of Engineering in Cairo. He left Cairo in 1901 when he was appointed lecturer in mechanical engineering at the University of Birmingham under the late Prof. F. W. Burstall. His experience in Cairo made him especially sympathetic and understanding of the difficulties of students from the East who studied at Birmingham.

In 1901 the Department of Mechanical Engineering was at Mason College, and it devolved upon Mr. Porter to design and lay out the engineering workshops and the power station for the Department in the new University buildings at Edgbaston. The power station was responsible for the supply of heat, electric power and lighting to the whole of the University buildings, and was in addition used as a heat laboratory. During the period 1914–18 the University buildings at Edgbaston were used as a military hospital, Mr. Porter being responsible for the maintenance and for the installation of the additional plant required. When normal conditions returned, he reorganized and re-equipped the Department on a new site near the power station.

Throughout his long career as senior lecturer and director of the power station, he took a keen and active part in University life, and until his retirement represented the non-professorial staff on the University Council.

He leaves a widow and two sons, his eldest son, who was a research engineer with the L.M.S. Railway, having predeceased him.

WE regret to announce the following deaths:

Dr. William Cramer, who was associated with the Imperial Cancer Research Fund during 1914–39, on August 10, aged sixty-seven.

Mr. R. A. Rye, Goldsmiths' librarian of the University of London during 1906–44, on September 14, aged sixty-eight.

Dr. B. O. J. Schrieke, delegate for the Netherland Indies at the United Nations Conference and formerly professor of social anthropology in the University of Amsterdam and later director of the Anthropological Section of the Colonial Institute, Amsterdam, aged fifty-five.

Prof. C. E. Spearman, F.R.S., emeritus professor of psychology in the University of London, on September 17, aged eighty-two.

NEWS and VIEWS

Research and Development in the United States

IN his message of September 6 to Congress, President Truman called for the establishment of a new Federal Agency to implement the recommendations of Dr. Vannebar Bush's recent report, "Science—the Endless Frontier" (see *Nature*, August 4). The development of atomic energy, said the message, is a clear-cut indication of what can be accomplished by the universities, industry and Government working together. Vast scientific fields remain to be conquered in the same way to derive the full profit in the future from what we have learned. The President urged upon Congress the early adoption of legislation for the establishment of a single Federal research agency which would discharge the following functions: promote and support fundamental research and development projects in all matters pertaining to the defence and security of the United States; promote and support research in the basic sciences and in the social sciences, as well as in medicine, public health and allied fields; provide financial assistance in the form of scholarships and grants for young men and women of proved scientific ability; co-ordinate and control scientific activities of Federal departments and agencies; and make fully, freely and publicly available to commerce, industry, agriculture and academic institutions the fruits of research financed by Federal funds. The message also called for an additional contribution of five hundred and fifty million dollars from the United States to the United Nations Relief and Rehabilitation Administration, and appealed for legislation for the early resumption of a vast programme of public works sponsored by the late President Roosevelt, urging that similar projects to the Tennessee Valley Authority should be undertaken for the development of the Columbia, Missouri and Arkansas Rivers and the central valley of California. "We shall seek," said the message also, "under the procedure prescribed in the lend-lease act and in subsequent agreements with other Governments, to achieve settlements of our war-time lend-lease relations which will permit, generally, a sound world-wide economy and will contribute to international peace and to our own national security."

Operational Control of Electricity Supply Systems

Supervisory equipment for the remote control of plant has proved to be thoroughly reliable and to facilitate efficient operation of electricity supply systems. In a paper read in London on March 14 by W. Kidd and E. M. S. McWhirter before the Institution of Electrical Engineers, the authors give the reasons for, and the steps taken to develop, the common-diagram control system, which enables an almost unlimited number of substations, etc., to be controlled completely from one diagram and control panel, and is sufficiently flexible to cater for the growth of an undertaking. It describes a wall-type system diagram which automatically indicates which substations have changed conditions, and therefore the area involved in any disturbance. The system diagram is equally extensible to accommodate new feeders and substations with a minimum of operating disturbances. Particulars of the circuits and apparatus, and comparisons of floor area, pilot and cost economies are given in the paper, together with information relating to an installation dealing initially with seventy-eight substations, to which others are being added.

The authors believe that, by the development of the ideas explained in the paper, the use of supervisory remote-control equipment has been extended on normal automatic-telephone switching practice to a wider application than was practicable with individual systems for large numbers of substations. This results in an economy of cost of equipment, of cost for control buildings, and of effort of the control staff. Operational control of large electricity supply systems will undoubtedly produce new requirements and problems as industrial, traction and domestic loads increase; but it is believed that, in the system described, a basis for meeting these requirements without adversely affecting present facilities has been provided.

Quaternion Centenary Celebration

The centenary of the discovery of quaternions by Sir William Rowan Hamilton has already been the subject of an article in *Nature* (**152**, 553; 1943). The Royal Irish Academy has now published (*Proc. Roy. Irish Acad.*, **50** A, 69; 1945) a record of the celebration in Dublin on November 8, 1943, which was attended by Mr. de Valera and two of his Ministers. Owing to the War, representatives of science from outside Ireland were unable to be present in person, but some of them sent messages or articles. The late Prof. G. D. Birkhoff of Harvard stressed the part that Hamilton's ideas played in the development of mathematics in the United States. Vectorial theory could be regarded as, to a large extent, latent in quaternions, like a fine melody in a great symphony. Vectors were more useful in classical physics, quaternions in the special theory of relativity, and tensors in gravitational relativity. Mathematicians and theoretical physicists should study all three with their historical development.

Sir Edmund Whittaker gave an account of the sequence of Hamilton's ideas, pointing out the gaps and apparent lack of harmony in existing accounts. With regard to Hamilton's recognition of the necessity for non-commutative multiplication, Whittaker says: "This was the supreme moment in the history of mathematical symbolism. It began the creative process which yielded not only quaternions, but all the other systems which broke away from the old rules —Cayley and Sylvester's matrices, Boole's symbolic logic, Grassmann's *Ausdehnungslehre*, Gibbs's dyadics, and the Heisenberg-Dirac algebra of quantum mechanics. Dr. A. J. McConnell dealt with the many distinguished members of Trinity College, Dublin, in the first half of the nineteenth century, including the mathematical physicists Hamilton, Lloyd, MacCullagh, Jellett and Haughton, the astronomer Brinkley, and the geometers Salmon, Booth, Hart, Charles Graves, Ingram and Stubbs. Dr. McConnell also printed the hitherto unpublished manuscript by Hamilton containing his first account of quaternions, written on the evening of the discovery. There are three other papers which demand more technical knowledge from the reader: "Quaternions and Matrices", by Prof. A. W. Conway; "A Modern Presentation of Quaternions", by Prof. F. D. Murnaghan, of Johns Hopkins University; and "The Icosian Calculus", by the Rev. J. R. Colthurst. The volume contains two plates: one a reproduction of an etching of Hamilton, the other a photograph of the first entry in his note-book of quaternion formulæ.

Mechanization of Sugar Beet Production

The Ministry of Agriculture, in agreement with the Ministry of Food, is sending a small mission to North America this autumn during the sugar beet harvest season to study progress there in research and development work on the mechanization of sugar beet cultivating and harvest. The party will consist of Mr. J. Bradley, principal scientific officer in charge of the engineering side of the National Institute of Agricultural Engineering; Mr. W. J. West, senior scientific officer on the agricultural side of the National Institute of Agricultural Engineering; Mr. F. E. Thornhill, agricultural officer from the British Sugar Corporation factory at Allscott, Salop; and Mr. H. S. Taylor, agricultural officer from the British Sugar Corporation factory at Brigg, Lincs. They will visit the principal growing areas in North America during harvest and will study practical operations in the field and in the factories in addition to the research and development work being undertaken by university centres, sugar factories and agricultural machinery manufacturers. It is hoped that the information and experience gained will be of considerable value to workers in this field in Great Britain, at a time when the problem of developing suitable machinery to meet the needs of British growers at the peak periods of cultivation and harvesting is of vital urgency. Special attention will be devoted to problems connected with the segmentation of sugar beet seed, the development of beet seed drills and the mechanization of sugar beet harvesting.

Narcotic Drugs

The two plants from which the raw materials of all the manufactured drugs covered by the International Conventions of 1925 and 1931 originate are the opium poppy and the coca bush. The former is used for the manufacture of morphine, heroin, codeine, dionine and other drugs, and the latter for the manufacture of cocaine. Unlike opium, coca leaves are little used in the form of medicinal preparations but are used in large quantities in the preparation of non-narcotic beverages. The Central Opium Board of the League of Nations, in a 32-page report prepared by Mr. L. F. Atzenwiler entitled "Pre-War Production and Distribution of Narcotic Drugs and their Raw Materials" (New York: International Documents Service, Columbia Univ. Press. London: George Allen and Unwin, Ltd., 1944. 50 cents.) summarizes and analyses the mass of world-wide material which the Board has received. The report shows the importance of each country as a producer, and the quantities and methods of disposal of the raw materials and manufactured drugs, by both producer and consumer countries. The world productions of raw opium and morphine, for example, were 18,504 tons and 137,360 kgm. respectively during the period 1934–37. Although such details will chiefly interest technicians, the main facts, trends and conclusions should be of great value as basic material for those concerned with future international work in this field.

Treatment of Arterial Injuries

The Medical Research Council's War Memorandum, No. 13 (H.M. Stationery Office, 1944), on "Arterial Injuries" has been prepared by the Vascular Injuries Sub-committee of the Council's War Wounds Committee. It is intended for those who have only a limited experience of the early treatment of arterial wounds. It carries the authority of the eleven leading British surgeons who sit on this sub-committee, and shows how far surgery has advanced in recent years. The pamphlet is divided into sections on anatomy, symptoms, treatment in forward battle areas or in hospitals where specific operative treatment is possible and on the management of limbs in which the circulation has been impaired. Appendixes deal with the technique of the suture of completely or partially divided arteries, the administration of heparin, the technique of blocking the sympathetic nervous system in the arm or leg and the writing of notes on vascular injuries. Primarily useful to surgeons, this pamphlet will no doubt interest others who may have to deal with this kind of injury in peace-time as well as in war.

Spicules on the Sun

The March issue of *Sky and Telescope* contains a brief notice of solar spicules, which are very small spike-like prominences most commonly seen in the polar regions of the sun. They have previously been seen during solar eclipses; but the coronagraph makes it possible to carry out daily observations of their numbers and duration. Dr. Walter O. Roberts is in charge of the observations made at Harvard College Observatory's Fremont Pass station at Climax, Colorado, and he has found that the spicules last only four or five minutes from the time of detection until they fade out completely. A spicule is brightest just before it attains its full height, and after reaching its maximum elongation it begins to fade out without any perceptible motion. Their average width is about 4,500 miles and most of them are only a few thousand miles high. The largest spicule sometimes lasts eleven minutes, and some of the smaller ones about two minutes. At times as many as twenty-five spicules have been seen simultaneously in a 60° arc of the sun's polar limb. They are not seen in disturbed regions of the sun, and they show material flowing outward from the lower layers of the atmosphere; this is in contrast to the ordinary solar prominences, which show material when it is falling inward to the sun's surface.

Smithsonian Publications

The Classified List of Smithsonian Publications Available for Distribution, May 1, 1925, compiled by Helen Munroe (Publication A.3802, Smithsonian Institution, Washington), contains only such works as can now be supplied by the Institution. It is not a complete list of all Smithsonian publications issued to date, and in particular publications of the United States National Museum and of the Bureau of American Ethnology are not included. The papers are arranged by subjects alphabetically, and the series in which they appeared are indicated. Those in the series of Contributions to Knowledge and Miscellaneous Documents are not public documents, but are available in printed editions and distributed without charge to public libraries, educational establishments and learned societies. They are supplied to other institutions and to individuals at the prices indicated. The Smithsonian Report volumes are distributed gratuitously to libraries and individuals throughout the world; but many of those of which the Smithsonian edition is exhausted can be purchased through the Superintendent of Documents, Government Printing Office, Washington. Applicants to the Institution should state the grounds for their request, as the Institution can only supply the papers as an aid to research or studies in which applicants are specially interested.

Announcements

The Committee of Privy Council for Medical Research has appointed Prof. P. A. Buxton, professor of medical entomology in the University of London, and Sir Alexander Fleming, professor of bacteriology in the University of London, to be members of the Medical Research Council from October 1, 1945.

Mr. J. Stewart Cook has been appointed organizing secretary of the British Association of Chemists as from July.

The life and work of the late Major Charles E. S. Phillips, secretary of the Royal Institution during 1929–45, will be commemorated at a meeting at the Institution on October 1 at 5 o'clock. Lord Rayleigh, the president, will take the chair and short addresses dealing with various aspects of Major Phillips' life and his connexion with the Royal Institution will be given by Sir Robert Robertson, Sir Richard Paget, Mr. R. S. Whipple, Prof. W. V. Mayneord and Sir Henry Dale.

The Imperial Institute is arranging a series of lectures on recent progress in geological investigation and mineral developments in the Colonies. Each lecture will be devoted to a particular territory and will be given by a recognized authority. The first of the series will be given on October 31 at 3 p.m. by Dr. F. Dixey, director of the Geological Survey of Nigeria, on "Nigeria, Its Geology and Mineral Resources". The second lecture in the series, by Dr. N. R. Junner, director of the Gold Coast Geological Survey, will be given in December, and others will follow.

The Hertfordshire Institute of Agriculture has unbound copies of *Nature* from 1926 onwards. Those dated up to the beginning of the War are available to bombed-out research institutions and libraries on payment of cost of packing and transport. Further information can be obtained from Mr. H. W. Gardner, Hertfordshire Institute of Agriculture, "Oaklands", St. Albans, Herts.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Artificial Production of Ergot in the Tropical Plains of Bengal

THE British Ministry of Health in 1941 made an appeal[1] for the cultivation within the Commonwealth of ergot, supplies of which had come hitherto from Central Europe, Spain and Portugal, where it occurs naturally. Wales and certain west coast places in England, and New South Wales, have taken up trial cultivation with a certain degree of success. English results are not definitely known; but the Australian ergot has an "alkaloid content well above the minimum standard provided in B.P., i.e. 0·05 per cent"[2]. In India, the Madras Agricultural Department[3] has taken up its experimental cultivation in the Nilgiri Hills and the produce has a similar alkaloid content.

It now appears that the localities selected both in Madras and New South Wales had a temperate climate and an altitude of a few thousand feet similar to that of its natural habitats. The importance of the present investigation lies in the fact that it is the first record of the artificial production of ergot sclerotia on rye plants under tropical conditions. The experiments were conducted at Calcutta: altitude 18 ft.; the shade temperatures, max. 67°–101° F.; min. 55°–62° F.; with a daily average max. temp. 85·1° F., min. temp. 64·3° F.; a total rainfall of about 13 in. during the period of investigation (from 17.10.44 to 23.3.45), the normal annual rainfall being about 65 in.

Four small plots, manured only with moderate doses of cow-dung, were sown with rye. The plants gave a good stand, and when they flowered they were sprayed by a hand atomizer with a water (sterile distilled) suspension of the conidial spores of the ergot fungus, *C. purpurea*, which was initially obtained by culturing bits of ergot from a commercial source. The sclerotia were first sterilized by steeping for a few seconds in absolute alcohol, then in 0·1 per cent mercuric chloride for five minutes followed by washing in sterile distilled water. Bits of sclerotia were then put in culture media and they gave rise to mycelial growth at 15–25° C., followed by sporulation in Leonian's, Kirchhoff's, rye agar, and wheat agar media.

Plot No.	Sowing date	Flowering date	Spraying date	Total no. of sprayings	Interval between sprays	Harvest date	% of infected tillers
I	17.10.44	24.1.45	31.1.45	6	24 hr.	14.3.45	89
II	30.10.44	2.2.45	7.2.45	6	24 hr.	20.3.45	86
III	15.11.44	4.2.45	8.2.45	8	24 hr.	25.2.45	85
IV	29.12.44	5.2.45	12.2.45	8	24 hr.	3.3.45	81

Spraying was done either in the morning, noon or Afternoon; the noon spraying was preceded by a sterile water spraying one hour earlier, in order to keep the glumes more open to facilitate infection.

Good infection of individual rye flowers occurred on all the plots, being externally evident by secretion of shining drops of light cream-coloured, thick 'honey-dew' drops at the tips of infected spikelets seven to ten days after spraying. This 'honey-dew' stage continued for some weeks. Three to four weeks from the first spraying, small purple sclerotia were found growing out through the glumes, replacing the ovaries. In seven to nine weeks from the first spraying, the sclerotia matured. They were now deep purple to almost black, hard, horny, pseudo-parenchymatous structures emitting a fishy smell. The number of sclerotia varied from 1 to 33 per panicle, 3–6 being the common number; when the number was greater their size was smaller. The biggest sclerotia was 3·6 cm. in length, 0·4 cm. in diameter, and weighed 0·248 gm. when air-dried. The yield obtained is also considered good.

ERGOT SCLEROTIA ON RYE EAR-HEAD.

The sclerotia were then harvested by hand picking and sent after six weeks storage at room temperature (20°–25° C.) in glass bottles for chemical assay to the director of the Bio-Chemical Standardisation Laboratory, Government of India, Calcutta. The results of the analysis reported by him is as follows: "The Ergot Sclerotia were assayed according to the method given in the 6th Addendum to B.P., 1943, and I find that ergots are of good quality, having a total alkaloid content of about 320 mg. per 100 gm. (B.P. figure: not less than 200 mg. per 100 gm.) and the Ergometrine content to be 72 mg. per 100 gm. (B.P. figure: not less than 30 mg. per 100 gm.). It will therefore be seen that these ergots are of a better quality than the B.P. standard Ergot".

Thus very good quality ergot can be easily produced in the plains of the tropics by artificial spraying of rye flowers with the ergot fungus spores, and if taken up commercially India will be in a position to export after meeting her own requirements.

Our thanks are due to Dr. B. Mukherji, director of the Bio-Chemical Standardisation Laboratory, for assaying the alkaloid content of our ergot, and to Prof. J. C. Sen Gupta, head of the Department of Botany, Presidency College, for his continued interest and help. Further, the senior author wishes to thank the Bengal Immunity Co., Ltd., Calcutta, for placing at his disposal the staff and the finances for this investigation.

J. C. SAHA.
S. K. BHATTACHARJEE.
Researches on Ergot Production,
Botanical Laboratory, Presidency College,
Calcutta. June 7.

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[1] *Nature*, 147, 393 (1941).

[2] Hynes, H. J., *Agric. Gaz. N.S. Wales, Mis. Pub.* No. 3218 (1941).

[3] Thomas, K. M., and Ramkrishnan, T. S., *Madras Agric. J.*, 30, No. 12 (1942).

B Vitamins in African Fermented Foods

FERMENTED foods of various kinds constitute a common part of most African diets. Their importance has long been recognized by students of nutrition as a means of relieving the monotony of primitive diets based preponderantly on cereals. The work of Delf[1] and of Fox and Stone[2] has served to establish the antiscorbutic potency of one fermented food, kaffir-beer. During the past two years, we have been engaged in a study of the vitamin B contents of these foods, employing microbiological procedures for the determination of riboflavin[3] and nicotinic acid[4] and fluorimetric methods for thiamin[5] and riboflavin[6].

The foods so far investigated fall roughly into two groups depending on whether the fermentation which they have undergone is non-alcoholic or partly alcoholic. In the former category are the 'soured' foods such as *marewu*, thin soured maize-meal porridge, and similar forms of soured porridge; *leting*, a sour product of maize-meal and kaffir-corn malt fermentation; and *amaas*, soured milk. Kaffir-beer, a thin sweetish-sour gruel with an alcohol content approximately the same as ordinary beer, is the chief example of an alcoholic fermented food. Reference will also be made to 'small beers' and related products which fall into this group.

The average values for vitamin content given below, while they do not indicate the considerable variations which occur, convey some idea of the useful contribution to vitamin intake made by these foodstuffs. The fortuitous mixture of simultaneous lactic, acetic and other fermentations which constitute souring does not greatly affect the vitamin content of cooked cereals. Comparison of *marewu* with the original meal on a dry basis reveals a loss of thiamin of about 30 per cent (largely due to the preliminary boiling) and increases in riboflavin and nicotinic acid of about 40 per cent.

In common with others who have investigated sprouted seeds, we have found malted cereals such as maize, kaffir-corn and various millets to be lower in thiamin but considerably higher in riboflavin and nicotinic acid than the unsprouted grains. Consequently it is advantageous, from a pellagra-preventive point of view, to combine the sprouted with the unsprouted forms. Subsequent souring and straining, as in the preparation of *leting*, leads to an increase in all three B vitamins, particularly in riboflavin.

	Solids (per cent)	Vitamin content (μgm./ml.)		
		Thiamin	Riboflavin	Nicotinic acid
Marewu	9·0	0·19	0·16	2 32
Leting	9·5	0·30	0·34	3·64
Kaffir-beer	8·7	0·47	0·54	4·66
'Second' beer ..	5·0	0·22	0·46	2·81
'Third' beer	3·4	0·23	0·38	1·65
Amaas	12·1	0·40	1·75	1·55

In making *amaas* from milk, only the nicotinic acid content is substantially affected, being reduced to one third. In the winter milks so far studied, the low ascorbic acid, carotene and vitamin A levels are influenced adversely only by the storage necessary for souring.

The preparation of kaffir-beer involves the souring of a meal-malt mixture, as in *leting*; boiling and cooling; addition of extra malt and water; alcoholic fermentation; and straining, which results in the final beer. The values given above were obtained with beers prepared from kaffir-corn and maize meals with kaffir-corn malt. The ingredients vary greatly in different parts of Africa, as also do the details of the basic process. Yet on a dry basis we have found little difference between kaffir-beers brewed by Africans, by municipal breweries and by mine compounds. The yeasts (*Saccharomyces* and *Torulæ*[7]), *Mucor rouxii*[8] and other microflora which play their part in the final alcoholic fermentation bring about a remarkable synthesis of the three B vitamins which we have measured, and probably of the remainder of the B complex. Thus the final beer is not merely an aqueous-alcoholic extract of the vitamins present in the original meal and malt. On a dry basis it now contains roughly twice as much thiamin and nicotinic acid and three times as much riboflavin as the original ingredients.

When the beer has undergone its final straining, a considerable residue remains. In the African home it constitutes an inoculum from which, with the aid of more malt, a series of small beers and other fermented foods can be produced. In this way the synthetic activity of the beer culture is prolonged and the ensuing 'second' and 'third' beers, while lacking the body or flavour of the original beer, are almost equal to it in vitamin content. The watery 'third' beer may be consumed as such by women and children; or it may be used to ferment cooked cereals such as steamed maize bread, to which sugar has been added. Through such by-products of the kaffir-beer brew the nutritive benefit derived by the whole African family is greatly extended. Similar fermented foods arise from the *leting* process, but we have not as yet secured samples of these products.

Previous work in this laboratory[9] has shown that African cereals provide an adequate level of thiamin. It is the remainder of the B complex which must be taken care of in order to achieve vitamin balance. From this point of view, our findings reveal the value of fermented foods as dietary supplements.

In a detailed description to be published elsewhere, full acknowledgment will be made of the assistance afforded us in this investigation. Here we can only express our thanks to the Director of Pathology, South African Medical Corps, who enabled one of us (J. M. T.) to take part in this work.

LEON GOLBERG.
J. M. THORP.
SHEILA SUSSMAN.
Biochemical Department,
South African Institute for Medical Research,
Johannesburg. June 14.

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[1] Delf, E. M., *Pub. S. Afr. Inst. Med. Res.*, 2, 47 (1921).

[2] Fox, F. W., and Stone, W., *S. Afr. J. Med. Sci.*, 3, 7 (1938).

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[4] Krehl, W. A., Strong, F. M., and Elvehjem, C. A., *Indust. Eng. Chem., Anal. Ed.*, 15, 471 (1943).

[5] Golberg, L., and Thorp, J. M., *S. Afr. J. Med. Sci.*, 8, 129 (1943).

[6] Unpublished modification of the method of Andrews, J. S., *Cereal Chem.*, 20, 614 (1943).

[7] Crone, W. M., *J. S. Afr. Chem. Inst.*, 24, 35 (1941).

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[9] Golberg, L., and Thorp, J. M., *S. Afr. J. Med. Sci.*, 10, 1 (1945).

Cultures of *Bacterium brunneum*

In connexion with some fundamental investigations on the removal of wool from sheepskins being carried out by the Council for Scientific and Industrial Research in Melbourne, we have made several endeavours to obtain a culture of *Bacterium brunneum*.

So far, we have been unable to locate a culture in any of the normal repositories such as the National Collection of Type Cultures, the American Type Culture Collection, the Pasteur Institute in Paris and the Bacteriology Department of the University of Pisa, and would like to ask the help of any of the readers of *Nature* who may know of or have a culture of the organism.

According to Bergey's "Manual", the organism was first isolated by Copeland[1] who called it *Bacillus brunneus*. Bergey *et al.* have transferred it to the genus *Flavobacterium* as *Flavobacterium brunneum* Bergey *et al.*

Assistance in this search will be greatly appreciated.

William J. Ellis.

Australian Scientific Research Liaison Office,
Australia House, W.C.2.

[1] Copeland, Rept. Filtration Commission, Pittsburgh, U.S.A., 348 (1899).

Unusual State at Birth of a Bat

During some recent observations on bats in Trinidad, B.W.I., an interesting variation from the normal state of young bats at birth was noticed. A pregnant specimen of *Artibeus planirostris trinitatis* K. And. (Phyllostomidæ) was under observation. Parturition occurred in the afternoon of March 9, 1945, and the young bat was closely examined within two hours and found to have its eyes open. As this seemed unusual, several further specimens of the same species were captured. These were all within a few days of parturition. The fœti were dissected out and examined, and it was found that these also had their eyes open.

This occurrence does not appear to have been recorded before for any family of bats. Dr. G. M. Allen[1], in his book on bats, summarized most of the published work on parturition and post-natal development of bats, but no mention of the above occurrence has been noted. Dr. H. B. Sherman, of the University of Florida, in a private communication, stated he knew of only one other case, which he observed recently occurring in *Tadarida cynocephala* (Molossidæ).

T. S. Jones.

Imperial College of Tropical Agriculture,
St. Augustine,
Trinidad, B.W.I.

[1] Allen, G. M., "Bats" (Harvard Univ. Press, 1939).

The Two-body Problem in Milne's Theory of Gravitation

In a recent communication[1], Dr. Camm has answered Schild's contention[2], that Milne's theory of the gravitational interaction of two massive particles in the field of the substratum is not Lorentz invariant and hence either invalid or else dependent on an arbitrary additional principle. Camm has shown that: (1) the consequences of Milne's theory are independent of any particular simultaneity convention, Lorentz-invariant or otherwise; and (2) the choice of such a convention, if Lorentz-invariant, is much more restricted than Schild supposes. While the particular convention, arbitrarily chosen by Schild, is shown to be invalid, Camm gives plausible reasons for adopting the convention,

$$t_1^2 - \mathbf{P}_1^2/c^2 = t_2^2 - \mathbf{P}_2^2/c^2,$$

linking the event $(t_1,\mathbf{P}_1)$ at the particle m_1 with the event $(t_2,\mathbf{P}_2)$ at the particle m_2. A conclusive reason, however, can be given for imposing this condition uniquely, as the following argument shows.

Using the t-scale, according to which the substratum is described as expanding uniformly from a point source, Milne[3] discovered a Lorentz-invariant form for the mutual gravitational potential of two superposed particles, m_1 and m_2, namely,

$$\chi = -\frac{m_1 m_2 c^2(t_1 t_2 - \mathbf{P}_1.\mathbf{P}_2/c^2)}{M_0\{(t_1 t_2 - \mathbf{P}_1.\mathbf{P}_2/c^2)^2 - (t_1^2 - \mathbf{P}_1^2/c^2)(t_2^2 - \mathbf{P}_2^2/c^2)\}^{1/2}},$$

where M_0 is the 'fictitious mass of the universe'[4], the numerical value of which is taken to be (in the present state of our knowledge) about $2{\cdot}4 \times 10^{55}$ gm. As χ is invariant for each fundamental observer of the quasi-continuous substratum, it follows that

$$\chi = -\frac{m_1 m_2 c^3 t_1}{M_0 |\mathbf{P}_1|},$$

where $(t_1,\mathbf{P}_1)$ are the co-ordinates assigned to an event at m_1 by the fundamental observer with whom m_2 coincides at the (local) epoch t_2; for this observer, of course, $\mathbf{P}_2 = 0$. Hence,

$$\chi = -\frac{m_1 m_2 c^3}{M_0 |\mathbf{P}_1/t_1|} = -\frac{m_1 m_2 c^2}{M_0 |\mathbf{V}_{12}/c|},$$

where $\mathbf{V}_{12}$ is the uniform velocity of relative recession of the fundamental observers with whom m_1 and m_2 are (momentarily) coincident, respectively.

Using the τ-scale, given by the clock-regraduation formula,

$$\tau = t_0 \log(t/t_0) + t_0,$$

it is easy to show[5] that the constant distance apart of m_1 and m_2 is λ_{12}, where

$$\tanh(\lambda_{12}/ct_0) = |\mathbf{V}_{12}/c|.$$

Hence, $$\chi = -\frac{m_1 m_2 c^2}{M_0 \tanh(\lambda_{12}/ct_0)}.$$

This formula was first given by Milne[6], but the present derivation appears to be more direct.

The outstanding feature of this form of the gravitational potential is its apparent independence of the local epochs, τ_1 (at m_1) and τ_2 (at m_2), and hence of any explicit relation between them.

The characteristic property of the substratum, in τ-time, is the co-existence of a public space and a public time, as in Newtonian physics. In examining any gravitational situation in the latter, it is usual to dissect the history of the system into a continuous set of maps recording 'world-wide' instants. In this way a meaning is given to the idea of conservation, for example, of energy. Similarly, in the gravitational situation considered here, the appropriate 'simultaneity condition' to impose, at least implicitly, is $\tau_2 = \tau_1$. This criterion is chosen freely, but the choice is unique and is not arbitrary. Reverting to t-time, it is easily seen[7] that, if $(t_1,\mathbf{P}_1)$ are the t-scale co-ordinates of the event τ_1 at m_1, and $(t_2,\mathbf{P}_2)$ those of the event τ_2 at m_2,

$$\tau_1 = \tfrac{1}{2}t_0 \log\left(\frac{t_1^2 - \mathbf{P}_1^2/c^2}{t_0^2}\right) + t_0,$$

and similarly for τ_2. Consequently, the relation, $\tau_2 = \tau_1$, tacitly assumed on the τ-scale, implies that, on the t-scale,

$$t_1^2 - \mathbf{P}_1^2/c^2 = t_2^2 - \mathbf{P}_2^2/c^2.$$

This is Camm's condition.

G. J. WHITROW.

Christ Church, Oxford.
July 9.

[1] *Nature*, 155, 754 (1945).

[2] *Phys. Rev.*, 66, 340 (1944).

[3] *Proc. Roy. Soc.*, A, 160, 7 (1937).

[4] *Proc. Roy. Soc.*, A, 160, 4 (1937).

[5] *Proc. Roy. Soc.*, A, 159, 178 (1937).

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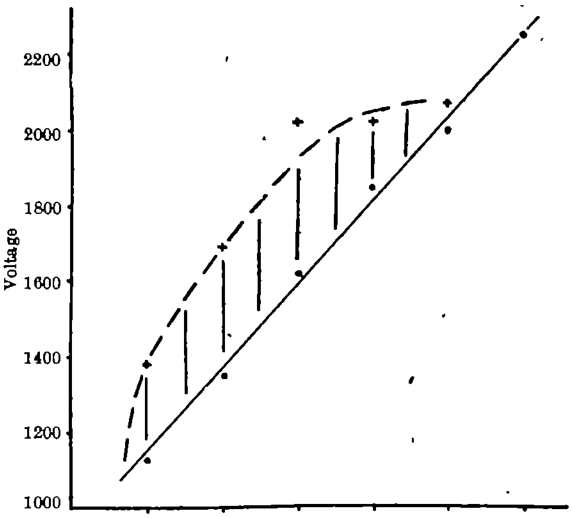
Effect of the Pressure of Alcohol Vapour on the Operation of the Fast Geiger-Müller Counter

As a result of the theoretical researches of Montgomery and Montgomery[1], Stever[2], Korff and Present[3], the operation of the fast Geiger-Müller counter is now very fully understood. In such a counter the discharge produced by a single ionizing particle is quenched by the following three processes: (*a*) The formation of a positive ion sheath which so reduces the field in the neighbourhood of the wire that further ionization by collision cannot take place. (*b*) The prevention of the emission of photo-electrons from the cathode by the rapid absorption of photons by the polyatomic vapour followed by the predissociation of the organic molecule. Processes (*a*) and (*b*) are of especial importance in the quenching of the initial discharge. (*c*) The prevention of the secondary emission of electrons from the cathode by positive ion bombardment by the predissociation of the organic molecule. Korff and Present have shown that the stopping of multiple discharges is due to process (*c*).

The role of the polyatomic vapour in the Geiger-Müller counter suggests that increasing the pressure of the vapour should improve the performance of the counter, since the efficiency of each quenching process would seem to be increased by increasing the quantity of vapour. A search through the literature showed that the references to the effect of the pressure of polyatomic vapour on the performance of the counter are very scanty. Only three observations[4,5,6] have been made, and the general trend of the results is to show that the efficiency of the quenching processes first increases and then decreases with increase in the pressure of the polyatomic vapour.

We have investigated this point by studying the variation in the length of the plateau of a Geiger-Müller counter of McCusker's design[7] with alcohol pressure for different pressures of argon. In order to avoid the possibility of the contamination of the cathode surface by the condensation of alcohol, all tests have been made at a temperature of 40° C. where the saturated vapour pressure of alcohol is 13 cm. mercury. The results, given in the accompanying table, show the effect of alcohol pressure on the starting potential and on the length of the plateau. The results for alcohol alone are plotted in the graph, the full line indicating the variation of starting potential and the broken line the onset of multiple discharges. The shaded portion is the region in which the counter is normally used to record ionizing particles.



STARTING POTENTIAL (FULL LINE) AND ONSET OF MULTIPLE DISCHARGE (BROKEN LINE) PLOTTED AGAINST PRESSURE OF ALCOHOL DIFFERENCES IN THE ORDINATES OF THE TWO CURVES REPRESENT PLATEAU-LENGTHS.

Two points emerge from the results: (1) the alcohol counter can be used only in a narrow range of alcohol pressures; and (2) the 'useful' pressure range is not affected to a great extent by the argon pressures used in this experiment; in fact, the argon acts merely as a 'filler' gas to increase the efficiency of the counter[5].

The graph brings out clearly that the variation in plateau-length is due to the difference in the variation of starting potential and of the production of multiple discharges. The variation of starting potential is seen to be almost linear, as might have been expected (Trost[4]).

Total pressure alcohol + argon (cm.)	Alcohol pressure (cm.)	Starting potential (volts)	Length of plateau (volts)
1	1	1130	250
2	2	1350	340
3	3	1620	400
4	4	1850	170
5	5	2000	70
6	6	2250	0
16	0		0
	0·5	1350	210
	2	1670	370
	2·5	1710	400
	3	1780	400
	4	2050	250
	5	2250	190
	6	2350	0
30	0		0
	2	2060	310
	3	2130	320
	4	2220	210
	4·5	2380	100
	6	2460	0

The curve showing the onset of multiple discharges as a function of pressure is determined by the efficiency of the quenching processes in preventing the rapid multiplication of electrons. Since this curve has the form shown, it is clear that the plateau will disappear as soon as the curve intersects the starting potential line. We would suggest that the decrease in the plateau is due to the failure of the quenching of secondary emission from the cathode by positive ion bombardment. The increase in starting potential causes the velocity of the positive ions to become so great that eventually there is a liberal emission of electrons from the cathode even at the starting potential.

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June 11.

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Flow of Water Through Very Narrow Channels and Attempts to Measure Thermomechanical Effects in Water

We have recently experienced instances where, particularly under humid tropical conditions, evacuated and sealed-off apparatus has shown marked deterioration due to the appearance of water vapour inside the evacuated space. While the presence of water vapour can be easily and definitely established, it appears that the channels which allow this transference of water are impervious to air. This means that although the apparatus is, within the limits of our measurements, completely airtight, it nevertheless allows measurable amounts of water vapour to pass into the vacuum.

Considering it possible that this indicated the existence of some unusual properties of flow of water through exceedingly narrow channels (as occurs in the case of liquid helium[1]), we carried out some experiments on the flow of water through channels of the order of 10^{-5} cm. in width. Fig. 1 shows the simple apparatus used; at the centre of a horizontal capillary tube about 10 cm. long, a 'porous plug' of tightly tamped jewellers' rouge was arranged, with a continuous water column extending *through*, and on each side of, the plug. Pressures both above and below atmospheric could be applied at P.

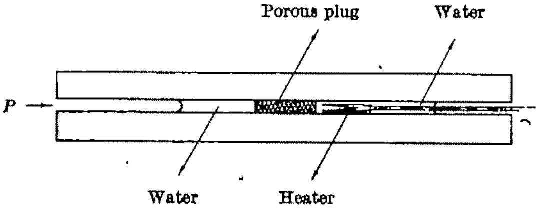

Fig. 1.

By observing the rouge particles under a high-power microscope, the average particle size was reckoned to be about 10^{-4} cm., and the average width of channel between the particles was about $1 \cdot 5 \times 10^{-5}$ cm. By observing the rate of flow of dry air through the plug *before* the introduction of the water column, and using the known value for the viscosity of air, we were able to obtain a reasonable check on both the number of channels through the plug and their average width. These figures were afterwards used to obtain a value for the viscosity of water when flowing through the porous plug.

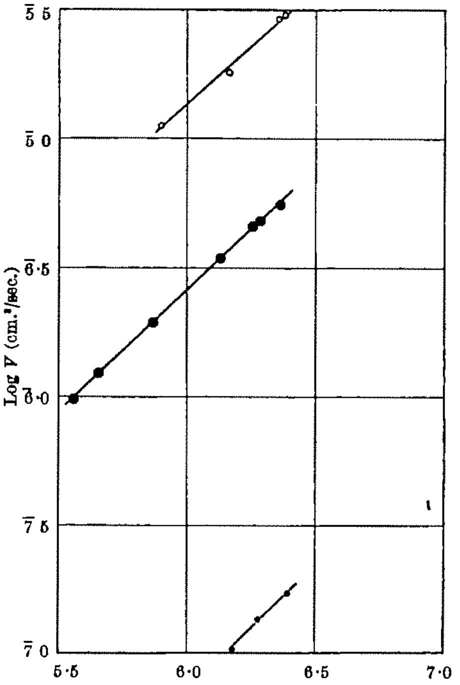

Fig. 2. Average channel width: o, 2×10^{-5} cm.; ●, $1 \cdot 5 \times 10^{-5}$ cm.; •, $0 \cdot 7 \times 10^{-5}$ cm.

Fig. 2 shows typical results for flow of water through several different porous plugs. The flow was purely laminar ($d \log V/d \log P \doteqdot 1$), even up to pressures of 3 atmospheres; but the actual value of viscosity appeared to be some five to ten times larger than for flow through smooth capillaries. In view of the uncertainty in the channel width, this is probably within the limits of error of our measurements; but there is clearly no evidence of anything in the nature of 'superfluidity'. Flow was observed through plugs of various materials (for example, rouge, French chalk, fine carborundum) and all gave practically identical results.

Thus the flow of water through channels of this width appears to follow the usual hydrodynamic laws; but, after the water had been forced clear of one side of the plug, it was then found impossible to drive any air through the plug, even with pressures up to 3 atmospheres applied at P. Water could, however, continue to be drawn backwards or forwards through the plug. Even when the water was totally removed from the capillary, the plug still remained vacuum tight, the flow of air being at any rate less than one ten-thousandth that observed when the plug was dry.

The possibility of the existence of a 'thermomechanical effect' in water (as occurs in liquid helium[2]) was also investigated, by inserting a heater on one side of the plug as shown in Fig. 1, and noting whether the rate of flow was altered when a heat input was applied. Although distinct changes in the rate of flow of the water were observed for quite small heat inputs (up to ¼ watt), it was clear that these changes were not to be associated with a thermomechanical effect. Two reasons lead us to this conclusion, namely, the facts that the rate of flow was *increased* whether the excess pressure P was above or below atmospheric, and that when P was zero no flow could be detected. The change in rate of flow is almost certainly due merely to the decrease in viscosity resulting from a rise in temperature when the heat input is applied. An attempt to observe a thermomechanical effect directly, with apparatus similar to that used in the quantitative measurements on helium[2], also gave a negative result. Landau[3] has stated that a thermomechanical effect in water is to be expected; but from our results it is clear that any such effect, if it exists, must certainly be less than one ten-thousandth of that observed in helium.

We must conclude that the flow of water through very narrow channels of the order of 10^{-5} cm. in width exhibits no very unusual features. The leakage of water vapour which is observed to occur into evacuated apparatus through such narrow channels must therefore be presumed to be due to surface tension action alone. Further, so long as the apparatus is maintained in a normally humid atmosphere, it will not be possible to detect any air leakage unless excess pressures are used exceeding that due to the surface tension, which can, of course, in channels of this width, reach very high values.

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Near Ultra-Violet Emission Bands of Benzene

IN the course of a study of the high-frequency discharge in benzene vapour, a set of bands in the spectral region 3000–2475 A. is obtained using oscillations in the frequency range 1765–1200 kc./sec. to excite the flowing vapour of benzene (pressure ~ 0·1 mm. mercury). These oscillations were produced in a modified Hartley circuit using a Mullard *PM4DX* valve. A Hilger medium quartz spectrograph was used as the resolving instrument to photograph the spectrum. The bands, which are degraded towards longer wave-lengths, occur in several distinct groups, six such being obtained in the present experiments. Measurements of the wave-lengths of the band heads show that they are identical with the bands obtained in the Tesla discharge in benzene vapour[1,2].

It has been possible to analyse most of the bands observed into five series designated as *A*, *B*, *C*, *D* and *F*, in all comprising about 76 band heads, in accordance with the nomenclature adopted by Sponer *et al.*[3], in their analysis of the near ultra-violet absorption bands of benzene. It may be recalled that these absorption bands of benzene are, according to Sklar[4], due to the forbidden electronic transition ${}^1A_{1g} \rightarrow {}^1B_{2u}$ which can only be made possible in the presence of a superposed non-totally symmetrical vibration of the type ε_g^+. In agreement with this deduction, all of these five series in emission, except the *F* series, involve the (606 cm.$^{-1}$) ε_g^+ vibration, either in the final state or in the initial state where its frequency falls down to 520 cm.$^{-1}$ exactly as in absorption or fluorescence spectra. The present data on the *F* series, however, are better represented if a frequency of 1610 cm.$^{-1}$ instead of 1596 cm.$^{-1}$ is assumed for the second ε_g^+ vibration which is also present in the ground state. The average discrepancy between observed and calculated values is 5 cm.$^{-1}$, which is equivalent to about 0·4 A. in this region and is within the limits of experimental error. About twenty band heads the intensity of which is low do not afford unambiguous classification. They fit in fairly well as members of one or other of the above series, involving frequencies both in the excited and the ground states; but it is also possible that they may involve some other new series altogether.

Whereas in absorption the positive members of the various series, that is, those involving frequencies of the excited state, are naturally predominant, in high-pressure fluorescence it is the negative members involving vibration frequencies of the ground state which form the bulk of the spectrum. Indeed, a rearrangement of the data of Ingold and Wilson[5] on the fluorescence spectrum of benzene clearly shows this expected difference between absorption and high-pressure fluorescence. The emission spectrum, which ought to contain both types of members of the series and hence present a much more complicated structure is, however, surprisingly simple. This is due to the circumstance that although both negative and positive members of the series are present, they are not loaded with more than 3 or 4 quanta of 160 cm.$^{-1}$, which is the difference between $(\alpha^1_{2g})''$ (400) and $(\alpha^1_{2g})'$ (240) non-totally symmetrical frequency. In contrast to this, it may be noted that most of the series observed in fluorescence are loaded with high quanta (in some cases up to 26) of this difference frequency.

The intensity distribution in each series of bands is roughly the same as that observed in the fluorescence spectrum, namely, an almost regular decrease with increasing quantum numbers of vibration in each series. The intensity of the various series is, however, in the following order: *B*, *F*, *D*, *A* and *C*. This may be contrasted with the intensity of the fluorescence series, which from the data of Ingold and Wilson gives the following order: *C*, *A*, *B*, *E* and *D*.

This analysis shows that the bands observed are, as in fluorescence, to be attributed to the electronic transition ${}^1B_{2u} \rightarrow {}^1A_{1g}$ in the benzene molecule.

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May 5.

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The 'Green Flash' at Sunset with a Near Horizon

THE observation of the 'green flash' with a near horizon, presumably at Harrow, recorded by Mr. D. R. Barber in *Nature* of August 4, p. 146, recalls one of which I gave an account in the *Meteorological Magazine* of October 1926. In this case the artificial 'horizon' was a building some miles off, and the colour of the flash was "a smoky white with a faint tinge of green". Mr. Barber also comments on the small saturation of the colours which he observed; it is possible that this is due, not to the nearness of the 'horizon', but to the smoky atmosphere of London.

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OXIDATION AND REDUCTION IN CHEMISTRY

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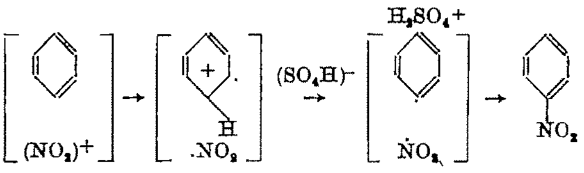
THE conjunction in *Nature* of July 14 of the article by Dr. D. H. Hey entitled "The New Organic Chemistry" with the correspondence on olefinic-α-halogenation prompts me to offer some comments and an intimation of various relevant results recently obtained in my laboratory.

The conclusion from Gomberg and Bachmann's results that "the laws of aromatic substitution did not hold", and the view that "free radicals were involved" in these and the various reactions studied by Hey and Waters are not warranted by the facts. The absence of *meta*-derivatives from the products of reaction is clearly indicative of some regularity of the substitution process and we therefore seek correlation with recognized processes. This reveals an apparently paradoxical correspondence with what has been termed cationoid substitution of benzene and its homologues on one hand, and with what is usually called anionoid substitution of nitrobenzene on the other. Further, however, the same applies to mercuration[1], and there is also agreement between the results of mercuration[2], and of coupling in presence of cupric salts[3], in the case of α-β-unsaturated esters and carbonyl compounds. We are thus confronted with two concordant instances of a paradox, which must be resolved instead of being merely relegated to a "New Organic Chemistry".

It has for some considerable time appeared to me to be a capital defect of the usual presentations of organic reactivity that, with so much that is cogent, there is insufficient expression, and so, frequently, insufficient realization, of the essential community of all chemical reactions. Considerations of history, simplicity and ultimate value all suggest that this expression should be, as, indeed, physical chemists have recognized, in terms of oxidation and reduction. It is for this reason that work in my laboratory has for some time been directed to the relationship between processes of substitution and those of oxidation[4]. This matter is, for example, only introduced towards the end of Ingold's monograph on "Organic Reactions"[5], and receives no specific attention in an exposition by Sir Robert Robinson[6]. Although, in his most recent discussion[7], an earlier suggestion by Jacobson[8] provoked attention to the matter, this did not suffice to obviate a conclusion endorsing the views of Hey and his associates. Indeed the currency which they have so long enjoyed is a testimony to the reality of the defect to which I point.

For these reasons, I prefer, even at the risk of some apparent retrogression[9], to adopt a device of approximation, representing organic reactions as a sequence of steps, involving the full electron transfer of oxidation and reduction processes, in which, however, the reactants remain "within the sphere of each other's action"[10], and to indicate this by the bracket notation conventional for such purposes among organic chemists.

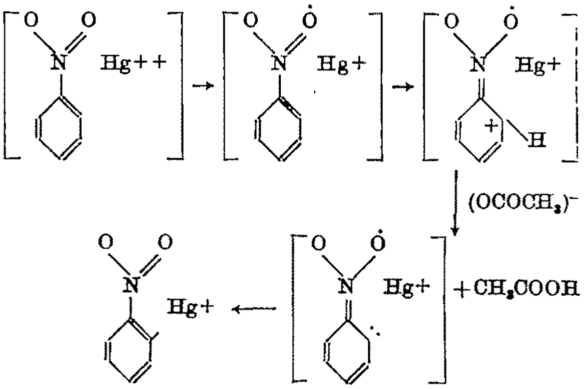
On this basis I formulate the nitration of benzene as follows:



I II

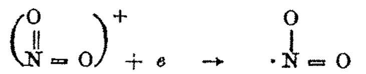
The initial change involves transference of a π-electron, while the transition from (I) to (II) by loss of a proton to the surrounding medium by means of the hydrogen bond mechanism is determined by the tendency to restore the aromatic condition and neutrality of the nucleus.

While the mode of application of this to mercuration is obvious, it illustrates the force of the suggestion[11] "that radicals, rather than ions, are produced more frequently in organic reactions than is usually realized". Also, it at once becomes apparent that, in the Bamberger and related reactions, with the systematic exploitation of which Hey and his co-workers have been concerned, the radical is not, as they have supposed, pre-existent or free, but generated as a transient phase during the reaction. Abstraction of an electron from the molecule of nitrobenzene will occur at an oxygen atom, and in the case of mercuric ion the sequence of changes can be expressed as follows:



The limitation of mercuration to the *ortho*-position is presumably due to retention of the mercurous ion (negatively charged by comparison with the mercuric state) in close proximity in the transition complex to the nitro group. A neutral phenyl radical has more freedom, so that *para*-arylation ensues.

Considerations of space preclude treatment here of the various issues arising from this discussion of the Bamberger and related reactions; but some perspective view of the matter is desirable at this point. Thus, since this hitherto unrecognized mode of *ortho-para* substitution arises from the variable degree of oxidation of the substituting agent, it should occur in other instances of this type. Accordingly, the ordinary *meta*-directed nitrations are accompanied by formation of notable amounts of *ortho*-derivative:

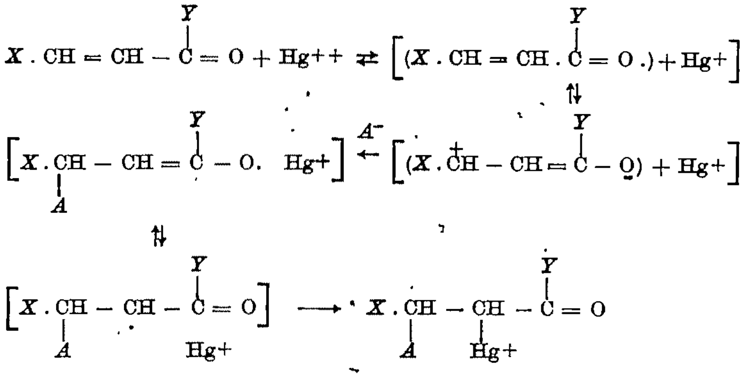


$$\left(\begin{array}{l}O\\ \|\\ N=O\end{array}\right)^{+} + e \rightarrow \begin{array}{l}\;\;O\\ \;\;|\\ \cdot N=O\end{array}$$

and to a greater extent with greater ease of surrender of an electron by the directive group. Similarly, as much as thirty per cent of *para*-disulphonation of benzene occurs at 183°[12].

The reaction of nitro-compounds with hydroxyl[13], cyanide[14], or fluorenyl[15] ions represents a variant of this mode of *ortho-para* substitution, in which both a molecule of the nitro-compound and the ion suffer loss of an electron to another agent, and to which similar considerations in regard to *ortho-* or *para*-substitution are applicable.

Whereas such substitution of nitrobenzene arises in general from activation of the nitro group by an agent which later becomes a substituent, ordinary *meta*-substitution, so far as it is due to activation[9], depends on that of an external agent, for example, by hydrogen bond formation. *Meta*-substitution is thus related to α-activation of carbonyl compounds by acids. If, however, an αβ-unsaturated carbonyl derivative be activated by mercuric ion, we have the following changes:



Although this case is closely related to the mercuration of nitrobenzene, there is here no need for proton extrusion, since the radical ion can achieve neutrality by accepting an anion A^- from the surrounding medium. Consequently the relative sites of mercuration are different in the two cases. Initial activation by cupric ion would generate cuprous ion which, as Waters has recognized, will in turn liberate from diazonium ion phenyl radical for arylation corresponding to the mercuration just discussed.

We need thus only speak of the 'new' organic chemistry in the sense that we enlarge the present relatively limited outlook to one exhibiting more explicit recognition of the relation of chemical reaction to processes of oxidation and reduction. Indeed, the formulation of chemistry in general needs a similar revision. Thus, we have as examples from inorganic chemistry related to those above, the substitutive mercuration of ammonia in the formation of Nessler's reagent, and the colour of those metallic compounds which do not contain coloured cations. The colour of mercuric oxide, for example, is presumably due to a relationship in its lattice which we may represent

$$Hg^{\cdot\cdot}O'' \rightleftharpoons Hg^{\cdot}O'.$$

A kinetic study of the nitrosation of dimethylaniline, carried out in conjunction with Dr. G. Baddeley and Mr. D. M. Lever, having revealed a similar accelerative influence of chloride ions to that observed in the case of diazotization, we have shown that a nitrosating reagent, with $[H^\cdot]$, $[Cl']$ and $[HNO_2]$ respectively 0·2, 1·9 and 0·1 molar, slowly dissolves metallic gold at the ordinary temperature, while solutions of benzene, ethyl benzene and tetralin in glacial acetic acid saturated with hydrogen chloride and containing a molar concentration of nitrous acid at 25° furnish small yields of chlorobenzene, 4-chloroethylbenzene and a mixture of *ac-* and *ar*-chloro-derivatives respectively. In other words, we have in the reagent

$$HNO_2 + H^\cdot + Cl' \rightleftharpoons H_2O + NO + Cl,$$

corresponding to the familiar reaction with iodide ion, and the acceleration noted above is due to atomic chlorine or to nitrosyl chloride, according as one regards the latter[11].

A kinetic study with Dr. G. Baddeley has shown that the rate of formation of 4 : 4′-diethoxy-1 : 1′-dinaphthyl from α-ethoxynaphthalene in presence of nitrobenzene and aluminium chloride is proportional to the concentration of the ethoxy-derivative. It thus involves the corresponding radical[11]. It is illustrative of the theme developed at the outset of this note that the course of the reaction is essentially that of benzene substitution as formulated above.

It seems to have been overlooked that olefinic α-oxidation was established so far back as 1894 when Wagner demonstrated the structure of sobrerol.

Studying the use of tertiary butylhypochlorite as a chlorinating agent, Dr. R. F. Garwood and I have shown it to (*a*) attack carbonyl compounds instantly, especially in presence of a trace of aluminium chloride, boron trifluoride, etc., forming, for example, mono- and di-chloroethyl malonates from ethyl malonate; (*b*) furnish a 65 per cent yield of Δ^2 *cyclo-hexenyl* chloride from cyclohexene under Ziegler's chlorination conditions. Also, independently following this up, Dr. Garwood has demonstrated the efficiency of this reagent in presence of benzoyl peroxide in chlorinating toluene, ethyl benzene, *p*-bromotoluene and *cyclo*-hexane to benzyl chloride, α-phenylethyl chloride, *para*-bromobenzyl chloride, and *cyclo*hexyl chloride respectively. Further, in contrast to the experience of Kharasch and Brown, using sulphuryl chloride and benzoyl peroxide, even *para*-nitrotoluene furnished some *para*-nitrobenzyl chloride.

It is obvious that fuller treatment of these various matters is required, and it is hoped to provide these in due course.

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[9] Compare Hughes and Ingold, *J. Chem. Soc.*, 608 (1941).

[10] Jones and Kenner, *J. Chem. Soc.*, 1848 (1931); 711 (1932).

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GAS RESEARCH BOARD

THE Gas Research Board—now responsible for the research activities of the British gas industry—has issued its fifth annual report (Gas Research Board, 1 Grosvenor Place, London, S.W.1), covering the session ending June 30, 1944. With the end of hostilities in Europe it has become possible to disclose some of the war-time activities.

Work on the gasification of coal in hydrogen under pressure had, by that time, passed from the laboratory into the works as a result of the installation of a small plant in the Bournemouth gasworks. In the initial stages a semi-coke, heated to 600° C., was treated with hydrogen under 50 atmospheres pressure. Under these conditions, gasification partly by liberation of volatile matter and partly by reaction of hydrogen with carbon takes place with great rapidity, for the formation of methane is an exothermic reaction. Another approach to the production of methane from coal is the synthesis from mixtures of carbon monoxide and hydrogen. Synthesis of liquid hydrocarbons is better known, but by choice of catalyst and conditions methane can also be obtained. The most important of the conditions is the almost complete removal of organic sulphur from the gas by processes which require very stable catalysts. Results of high promise have been obtained and suggest that fuel gas may soon be distributed almost free from sulphur.

All this work aims at the preparation of a fuel gas without the limitation of starting from high-class coking coal, rather indeed from any coal. This achievement will almost certainly be accompanied by the production of gas from sulphur.

In recent years it has been recognized that although heat is transferred by convection and radiation, the differentiation of the two may be important. In certain operations, especially those involving drying, radiation may prove more effective than convection. Effectiveness may be influenced by the quality not only of the source of radiation but also by that of the surface receiving the radiation. The report shows that the Gas Research Board is actively engaged in this field because gas-heated surfaces are specially effective for radiant heating, and this promises great industrial application.

Another branch of the Board's activities involves the separation by refrigeration of coal gas into its constituent gases, whereby advantage can be gained from the special properties of each.

The report shows that the Board, in spite of war-time difficulties, is making rapid progress in the development of new techniques for the manufacture and use of gaseous fuel.

FREQUENCY OF EARTHQUAKES IN CALIFORNIA

ACCORDING to Gutenberg and Richter, the southern California area, including the Owens Valley, has about one half of one per cent of the seismic activity of the globe ("Frequency of Earthquakes in California." By B. Gutenberg and C. F. Richter. *Bull. Seis. Soc. Amer.*, 34, No. 4, 185; 1944). This conclusion is arrived at by considering statistically up-to-date information concerning earthquakes, employing the instrumental magnitude scale.

The magnitude M of an earthquake was originally defined as proportional to the logarithm of the maximum trace amplitude on the seismogram of a standard torsion seismometer distant 100 km. from the epicentre, and having a normal shallow depth. The magnitude scale is chosen to make $M = 0$ correspond to the smallest instrumentally recorded shocks. It is found that $M = 2$ corresponds to the smallest shocks ordinarily reported felt, $M = 4{\cdot}5$ causes slight damage, $M = 6$ earthquakes are moderately destructive, and $M = 8{\cdot}5$ corresponds to the largest recorded shocks.

Since 1921, the following shocks in the California–Nevada region have had magnitude 7 or greater: Jan. 31, 1922 (7·3), off the north coast; Jan. 22, 1923 (7·1), off the north coast; Nov. 4, 1927 (7·0), off Point Arguello; Dec. 20, 1932 (7·3), west-central Nevada; Dec. 31, 1934 (7·0), south of the Imperial Valley. In the present century, two shocks in the same region have exceeded magnitude 7·5: April 18, 1906 (8·25), central California; Oct. 2, 1915 (7·75), north-central Nevada.

This gives the California–Nevada region about 90 per cent of the seismic activity of the United States.

According to the authors, the expected occurrence of about four great earthquakes per century in the California region by no means excludes the possibility that double that number might occur in a given century, or that a whole century might pass without even one. Further, the events are not strictly independent. A great shock, such as that of 1906, represents a regional release of strain; after the immediate aftershocks have subsided, it may be expected to be followed by a period of abnormal quiet, as is probably now the condition in central California. It is worth noting that great shocks are to be looked for only in association with the major active faults and structures, such as the San Andreas fault zone and the trough of the Owens Valley. The other faults and active structures are characterized at most by moderately destructive earthquakes like those at Santa Barbara and Long Beach.

THE STONE AGE IN EAST AFRICA

IMMEDIATELY before the War, industries belonging to a so-called Tumbian culture were being recognized at many sites in eastern and western Africa. First noticed by Dr. X. Stainer in the Congo, industries of similar types were soon being identified in many other areas. Dr. Menghin and T. P. O'Brien (in his book on the prehistory of Uganda) went so far as to suggest that the Tumbian culture was derived directly from that of the *coups de poing* makers, that it could be described as a sort of Acheulean gone to seed. Prof. H. Breuil, however, in a recent study of Dr. Cabu's finds, denies the existence of the Tumbian as a distinct culture, and he and Prof. van Riet Lowe suggest that the industries represent only a variation of the Sangoan culture of Uganda with strong Fauresmith affinities (*Trans. Roy. Soc. of South Africa*, 30, pt. ii; 1944).

Dr. Leakey and Archdeacon Owen have now entered the ring, and in the first Occasional Paper of the Coryndon Memorial Museum, entitled "A Contribution to the Study of the Tumbian Culture in East Africa", they unequivocally uphold its status as a culture. Owen and Leakey's publication deals mainly with a series of sites, chiefly from the Kavirondo area, where industries belonging to various stages of this debatable culture have been discovered. There are several pages of illustrations. In conclusion, there is a general discussion on certain aspects of the Stone Age in Kenya, followed by an appendix, where Breuil and Lowe's work, quoted above, is cited, and the conclusions there set out denied.

As a personal opinion I can only add that every so-called Tumbian assemblage of implements which I have seen has appeared to contain several elements and to have been a mixture of the relics of more than one culture. Certain types do certainly seem to be derived from a *coup-de-poing* prototype. There is no reason to deny the possibility of a late survival of the early palæolithic cultures in parts of Africa where the sharp division lines resulting from the several glacial maxima are absent. That a part of the so-called Tumbian is, as the authors claim, something new to us and derivative from the Acheulean would seem to be quite possible; but that the industries discussed contain elements from other cultures and that therefore a pure Tumbian industry has yet to be isolated is also more than likely.

M. C. BURKITT.

FORTHCOMING EVENTS

Saturday, September 22

BRITISH PSYCHOLOGICAL SOCIETY (at Tavistock House, Tavistock Square, London, W.C.1), at 2.30 p.m.—Mr. E. G. Chambers: "Statistical Psychology, a Plea for Scientific Method"; Mr. Ranyard West: "The Contribution of Psychology to Politics".

Monday, September 24

ASSOCIATION OF AUSTRIAN ENGINEERS, CHEMISTS AND SCIENTIFIC WORKERS IN GREAT BRITAIN (at the Austrian Centre, Swiss Cottage, 69 Greencroft Gardens, London, N.W.6), at 7.30 p.m.—Dr. M. D. H. Strauss: "The Physical Basis of the Atom Bomb".

Tuesday, September 25

ROYAL PHOTOGRAPHIC SOCIETY, SCIENTIFIC AND TECHNICAL GROUP (at 16 Prince's Gate, London, S.W.7), at 6 p.m.—Dr. G. B. Harrison: "How it Works in Photography", No. 1. "The 'Light and Shade' of Image Formation".

QUEKETT MICROSCOPICAL CLUB (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 7 p.m.—Conversation and the Exhibition of Specimens.

Thursday, September 27—Friday, September 28

FARADAY SOCIETY (at University College, Gower Street, London, W.C.1).—General Discussion on "Oxidation".
Thursday, September 27, at 11 a.m.
Friday, September 28, at 10.30 a.m.

Friday, September 28

BIOCHEMICAL SOCIETY (in the Human Nutrition Research Unit of the Medical Research Council, National Hospital for Diseases of the Nervous System, Queen Square, London, W.C.1), at 11 a.m.—Scientific Papers and Demonstrations.

PHYSICAL SOCIETY, OPTICAL GROUP (Department of Physics Imperial College, London, S.W.7), at 3.15 p.m.—Mr. E. Wilfred Taylor: "Evolution of the Dividing Engine"; at 5 p.m.—a film entitled "Motion-picture Records of the Whole Sky" will be shown.

INSTITUTE OF WELDING, EAST SCOTLAND BRANCH (at the Heriot-Watt College, Chambers Street, Edinburgh), at 7.30 p.m.—Mr. A. Stephenson and Mr. D. Llewellyn: "Welding: Past, Present and Future".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

AGRICULTURAL ASSISTANT EDUCATION OFFICER—The Chief Education Officer, County Education Office, Stracey Road, Norwich, endorsed 'Agricultural Assistant Education Officer' (September 29).

SENIOR ENGINEERING ASSISTANT—The Surveyor, Hebburn Urban District Council Offices, Argyle Street, Hebburn (September 29).

LABORATORY TECHNICIAN—The Medical Superintendent, Birmingham Mental Hospital, Winson Green, Birmingham (October 1).

CHAIR OF CHEMICAL ENGINEERING tenable at the Imperial College of Science and Technology—The Academic Registrar, University of London, Richmond College, Richmond, Surrey (October 3).

ENGINEERS (temporary staff) by the Government of Nigeria for the Public Works Department—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting E.1899.A (October 5).

LECTURER IN ENGINEERING SUBJECTS in the Royal Aircraft Establishment Technical School, Farnborough, Hants.—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting C.2641.A (October 5).

SUPERINTENDENT (with qualifications in chemical technology and chemical engineering research applied to explosives) in a Government Research Establishment—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting F.3886.A (October 5).

GEOLOGIST by the Government of Iraq—The Ministry of Labour and National Service, A.9, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting F.4826.A (October 5).

PHYSICISTS (2) for a Petroleum Research Station near London—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting A.1028/4.XA (October 6).

LECTURER IN CHEMICAL ENGINEERING in the Department of Oil Engineering and Refining—The Secretary, The University, Edmund Street, Birmingham 3 (October 8).

TECHNICAL ASSISTANT (Chemist) in the Sewage Disposal Department—The Town Clerk, Guildhall, Nottingham (October 15).

ASSISTANT LECTURER AND DEMONSTRATOR IN BOTANY—The Secretary, West of Scotland Agricultural College, 6 Blythswood Square, Glasgow, C.2 (October 21).

THIRD LECTURER IN BACTERIOLOGY and ASSISTANT BACTERIOLOGIST in the Public Health Laboratory—The Secretary, The University, Birmingham, 3 (October 31).

READERSHIP IN PUBLIC HEALTH tenable at the London School of Hygiene and Tropical Medicine—The Academic Registrar, University of London, Richmond College, Richmond, Surrey (January 1).

SENIOR SCIENCE MASTER in the King Edward VII School—The Director of Education, Education Office, Leopold Street, Sheffield, 1.

UNIVERSITY ASSISTANT IN THE DEPARTMENT OF NATURAL HISTORY in the United College, St. Andrews—The Secretary, The University, St. Andrews.

LABORATORY ASSISTANT IN THE DIVISION OF HISTOLOGY—The Bursar, Royal Veterinary College, Camden Town, London, N.W.1.

TECHNICAL ADVISORY OFFICER—The Executive Officer, Shropshire War Agricultural Executive Committee, County Buildings, Shrewsbury.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Colonial Research, 1944–45. 1. Colonial Research Committee, Second Annual Report; 2. Colonial Products Research Council, Second Annual Report; 3 Colonial Social Science Research Council, First Annual Report. (Cmd. 6663.) Pp. 32. (London: H.M. Stationery Office, 1945.) 6*d.* net [238

The British Radio Industry in War and Peace. Pp. ii+26. (London: Radio Industry Council, 1945.) [238

British Electrical and Allied Industries Research Association. Technical Report (Reference Y: T6): Capacity Current Heating—Résumé of Published Information. By T. H. Messenger and D. V. Onslow. Pp. 20+2 plates. (London: British Electrical and Allied Industries Research Association, 1945.) 9*s.* [238

Imperial Bureau of Horticulture and Plantation Crops. Technical Communication No. 16: Further Work on Plant Injection for Diagnostic and Curative Purposes. By W. A. Roach and W. O. Roberts. Pp. ii+12. (East Malling: Imperial Bureau of Horticulture and Plantation Crops, 1945.) 1*s.* 6*d* [238

Ovaltine Research Laboratories. Annual Report, 1944. Pp. 6. (London: A. Wander, Ltd., 1945.) [238

Other Countries

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No 184: Fellmongering Investigations, Papers 1–12. By F. G. Lennox, Margaret E. Maxwell and W. J. Ellis. Pp. 232+8 plates. (Melbourne: Government Printer, 1945.) [317

Smithsonian Miscellaneous Collections. Vol. 104, No. 11: The West Atlantic Boring Mollusks of the Genus *Martesia*. By Paul Bartsch and Harald A. Rehder. (Publication 3804.) Pp. ii+16+3 plates. Vol. 104, No 12. The Solar Constant and Sunspot Numbers. By L. B. Aldrich. (Publication 3806.) Pp. ii+6. (Washington, D.C.: Smithsonian Institution, 1945.) [18

Preliminary Report on the Third Gujurat Prehistoric Expedition, by H. D. Sankalia and I. Karvé; and Human Remains Discovered So Far, by I. Karvé and G. M. Kurulkar. Pp. 16+9 plates. (Bombay: *Times of India* Press, 1945.) 6.8 rupees. [18

Indian Forest Records (New Series). Utilization, Vol. 3, No. 4: The Testing of Indian Plywood Tea Chests, and Suggestions for Establishing a Standard Type. By V. D. Limaye. Pp. 10+4 plates. (Dehra Dun: Forest Research Institute, 1945.) 9 annas. [18

Proceedings of the United States National Museum. Vol. 96, No 3190: The Genus *Fundella* Zeller; a Contribution toward a Revision of the American Pyralidoid Moths of the Family Phycitidae. By Carl Heinrich. Pp. 105–114+plates 4–6. (Washington, D.C.: Government Printing Office, 1945.) [18

Forty-seventh Annual Report of the Carnegie Museum for the Year ended December 31, 1944. Pp. 37. (Pittsburgh: Carnegie Institute, 1944.) [18

Anglo-American Caribbean Commission: Committee on Agriculture, Nutrition, Fisheries and Forestry of the Caribbean Research. Fisheries Series, No. 2. Fresh and Brackish Water Fish Culture. Pp. ii+32. (Washington, D.C.: Anglo-American Caribbean Commission, 1945.) [18

New South Wales: Department of Mines, Geological Survey. Mineral Resources, No. 38: Part 1. The Gulgong Gold Field, by Leo J. Jones; Part 2. Magnetic Prospecting of the Gulgong Deep Leads, by J. M. Rayner. Pp. 168+5 plates. 9*s.* Mineral Resources, No. 39: Geology and Underground Water Resources of the East Darling District. By C. St. J. Mulholland. Pp. iii+80+3 plates. 6*s.* (Sydney: Government Printer, 1940.) [98

Catalogues

50 Years of Scientific Instrument Manufacture. Pp. 28. (London: Cambridge Instrument Co., Ltd., 1945.)

The Use of Cacodylates. Pp. 4. (London: R. F. Reed, Ltd., Barking, 1945.)

A Catalogue of Books, Old and Modern, in various Departments of Literature. (No. 498.) Pp. 38. (Cambridge: Bowes and Bowes, 1945.)

Dept. Science
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NATURE

No. 3961 SATURDAY, SEPTEMBER 29, 1945 Vol. 156

CONTENTS

	Page
Colonial Universities and their Functions	373
The Early Human Embryo. By Dr. C. H. Waddington	375
Classification of Recent Philosophy. By Prof. A. D. Ritchie	376
The Animal in Health. By Dr. John Hammond, F.R.S.	377
A Text-book of Heat	377
A New Cosmogony of the Solar System. By Dr. A. Hunter	378
The Scapegoat in Modern Europe	380
The Atomic Bomb	382
Archives of the Lake. By Dr. H. Godwin, F.R.S.	383
Obituaries :	
Dr. Alexander Sand, F.R.S. By Prof. T. A. Stephenson	383
Prof. Ludwik Wertenstein. By Dr. J. Rotblat	384
Prof. Walter Makower, O.B.E.	385
Miss E. R. Saunders. By Prof. J. B. S. Haldane, F.R.S.	385
Dr. G. V. Buchanan. By Prof. F. Wood Jones, F.R.S.	385
News and Views	386
Letters to the Editors :	
A New Test for 2×2 Tables.—Prof. R. A. Fisher	388
A Classical Theory of Electromagnetism and Gravitation.—Dr. H. C. Corben	388
Cosmic Rays and Kinematical Relativity.—Prof. Herbert Dingle	389
Interaction of Aluminium Halides with the Xylenes.—H. Campbell and E. F. G. Herington	389
A Sexual Reproduction Cycle of *Trypanosoma congolense* Broden.—R. N. T.-W.-Fiennes	390
Multiplication *in vitro* of Koch Bodies of *Theileria annulata*.—I. Tchernomoretz	391
Histological Fixation of Locomotory Patterns.—H. W. Lissmann	391
A Modification of Slide-Culture Technique.—P. H. B. Talbot	391
Fatty Constituents of Tubercle Bacilli as Growth-Inhibitors of the same Bacilli.—Dr. Ng. Ph. Buu-Hoï	392
A Case of Molybdenum Deficiency in New Zealand.—Dr. E. B. Davies	392
Calomel and Onion Eelworm.—Dr. T. Goodey	393
Control of Dry Rot of Seed Potatoes by Dusting.—Dr. C. E. Foister, Dr. A. R. Wilson and Dr. A. E. W. Boyd	394
Growth Inhibition in Pea Seedlings. By E. Dorothy Brain	397
Cell Proliferation, Carbohydrate Breakdown, and Hydration of Enzyme Protein. By Dr. A. Lasnitzki	398
Two New Antibiotics. By Dr. G. Lapage	398
United States Antarctic Discoveries. By Prof. R. N. Rudmose Brown	399
Recent Scientific and Technical Books	Supp. ii

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COLONIAL UNIVERSITIES AND THEIR FUNCTIONS*

IN the second part of its report, the Asquith Commission surveys in considerable detail the special problems involved in the provision of professional and vocational courses in the universities and university colleges, and the needs of medicine, agriculture, veterinary training, law, engineering, and the training of teachers; and the medium of instruction and linguistic training are discussed in a series of chapters with appropriate recommendations. These include, for example, the establishment of medical schools to serve those Colonial regions which do not now possess them, and refer to the fruitful opportunities for research which medicine presents in the Colonies; but like the Goodenough Inter-Departmental Committee on medical schools in Britain, the Commission recommends that medical schools should be integral parts of universities, and that full participation in the life of universities and close association with those following other branches of learning will provide the greatest stimulus to teachers and encourage medical students to develop those qualities of mind and character which go to the making of good medical practitioners. There is sage counsel on the functions of universities and university colleges in agricultural education, and a clear conception of the contribution of the university to agricultural education through its extra-mural activities, the importance of which is also well brought out in the first part of the report. The exceptional importance of veterinary training is recognized, and also the value and limitations of civil engineering, instruction in which up to B.Sc. standard in Colonial universities or colleges is recommended, although it may for a time be difficult to provide in the Colonies either the practical experience of good engineering work or facilities for fundamental research.

On the training of teachers, the Commission recognizes that, while it may for many years be impracticable to require that all teachers in the secondary schools shall be graduates, teachers in the higher and middle forms should be graduates. The university should concern itself primarily with the training of intending teachers who have already graduated, and with other teachers required for secondary schools. Recommendations as to the type of instruction are included; the department of education should be under a professor, and should be a centre of research in the many problems of school education in Colonial conditions; while in organizing the department of social sciences in the faculty of arts, the university should provide for research into linguistic problems to be pursued in close association with the departments of anthropological and sociological studies.

The third part of the Asquith Commission's report summarizes the report of the West Indies Committee and endorses its recommendations. As already noted, the chief of these is the establishment of a single University of the West Indies at the earliest possible date. The first step should be the foundation of a university college, which, in order to establish its academic standards and win public confidence and esteem, should work for the most part for the external degrees of a university of repute. After a short period of apprenticeship, the college would obtain a charter and begin its autonomous life, providing initially for some 400–500 students, men and women. The Committee insists that the university should be a single centralized institution and entirely residential. Three years would be the usual period of residence and study to qualify for a degree, and the university should teach the basic subjects appropriate to degrees in arts and science, and should include a faculty of medicine. Provision should be made to enable as many students as possible to pursue in Britain or elsewhere such further professional and postgraduate training as may not be available in their own university. The university should also be the headquarters of an important department of extra-mural studies through which its influence would be projected into all the West Indian Colonies. The Secretary of State for the Colonies has just announced that the proposal has his full support, and that he is prepared to consider making a grant under the Colonial Development and Welfare Act towards building costs.

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* Continued from p. 347.

The arguments which lead to these findings reflect the whole spirit of the Asquith Report, with which the West Indies Committee report makes a coherent whole. The Committee was impressed with the strong evidence of the deficiency of technical education and the urgent need for skilled workers in nearly all branches of industry. There was a remarkable degree of local support for a unified institution, and the choice of Jamaica as site was reached last but independently by all members of the Committee. The same high conception of an educational system as a dynamic system inspires its report. The university is regarded as not simply enriching the fields of higher learning, but also influencing deeply the whole system of education by returning into its service, among others, secondary school and training college teachers, and in many intangible and indirect ways affecting the attitude of the community as a whole towards education and learning. Further, the essence of a university is that it should be a community of men and women pursuing a wide range of studies, humane and scientific, so that a continuous process of mutual education and intellectual broadening goes on, outside as well as inside the lecture rooms and laboratories. The Committee's recommendations spring from its faith in the positive contribution that a university could make to all the Caribbean territories, which are now for the first time being brought into a co-operative relationship. The Committee believes that a university should be the intellectual centre of a region to which its own graduates may look for encouragement and refreshment, and which may also be a meeting-ground for all those pursuing knowledge at the higher levels. Finally, it insists that the university should be a centre for research as well as teaching, and envisages the university as the main centre of research into the physical and social problems of the whole region. Indeed, the chapter on research, though shorter than that in the Asquith Commission's report, is nevertheless no less worthy of careful study.

Space does not permit further quotation from this discerning and admirably presented report, and reference can be made only to one other point. The problem of training in medicine is beset with difficulties as regards the immediate future, for the establishment of a complete faculty of medicine located at the seat of the university in Jamaica and working in association with the Kingston General Hospital can become operative only when the complete university scheme comes into existence. The need is urgent, and on investigating the possibility of providing a medical course in the West Indies which would function as an emergency measure until the university comes into full operation, the Committee recommends the adoption with some minor modification of Sir Rupert Briercliffe's scheme for the establishment of a temporary medical school in Trinidad, working in association with McGill University, Montreal.

The report of the Elliot Commission is the longest of the three reports; but as already indicated, it is not unanimous, nor, save perhaps in passages of the minority report, is it inspired by quite the same clear conception of the university ideal. There is an able survey of the general and of the educational background of West Africa and a lucid description of the present institutions for higher education there; but in their discussion of the future development of higher education, of the supply and training of teachers, of medical and health education, including dentistry, of agriculture, forestry, and animal health, and of technical education, the majority seem sometimes to have lost sight of general principles and objectives in a mass of local detail. The general case for the creation of universities in the Colonial areas argued by the Asquith Commission is indeed fully endorsed. Moreover, the proposals of the majority to develop a new university college at Ibadan in Nigeria (including faculties of arts and science, with schools of medicine, agriculture, forestry and animal health) to serve the whole of West Africa; a development of Achimota College in the Gold Coast (including faculties of arts and science, and an institute of education) and a reorganization, on a new site, of Fourah Bay College, which will also serve the Gambia (to include courses in arts and science up to the intermediate level and a teacher training course) are supported by the three West African members of the Commission. These university colleges are themselves to be centres of research and to collaborate closely with research organizations in West Africa, and the guidance of the Inter-University Council for Higher Education in the Colonies proposed by the Asquith Commission is welcomed. Higher education is here also considered as an integral part of a complete educational system. But the minority report appears to be argued more closely from first principles. This report rejects the majority proposals as likely to impede the earlier provision of a full range of university facilities in the West African territories. This aim requires that any future university must have all the necessary material facilities planned and provided without delay, with adequate staff of high calibre. The recognition outside West Africa of any university institution will depend not only on the quality of the teaching given to its students but equally on its research achievements. The minority also insist that no university institution can fulfil its purposes unless it is comprehensive in scope; students of a variety of faculties must work together in a single institution and share a corporate life; and lastly, no college aiming at university status can progress with any speed towards its goal unless the students entering it are adequate both in numbers and in equipment for university study.

It is on these principles, and particularly on the incapacity of the areas to supply an adequate flow of students able to pursue successfully degree courses within the period normally allocated to these courses in universities of Great Britain, that the minority dissent from the recommendations of the majority, although with much of the majority report they are in agreement. They are deeply impressed with the intense need for the development of studies in arts and science to the same level side by side. In their view, every endeavour should be made to build up a first-class scientific centre by concentrating scientific development at the West African University College at Ibadan, where co-operation with those working in medicine, animal health, agriculture and forestry will provide both the environment and impetus to the carrying out of much-needed scientific research, and at the same time will greatly aid research in these subjects themselves. They fear that the majority proposals to duplicate facilities in science will inevitably hinder the development of research both in science and in arts. They lay much stress on the development of post-secondary vocational education and the need for a wide extension and improvement of vocational and technical education in order that the schemes now being prepared by Colonial Governments under the Colonial Development and Welfare Act may be implemented. The majority report itself recommends the establishment of technical institutes for the dependencies of Nigeria, the Gold Coast and Sierra Leone, as well as the appointment of three technical officers to survey the existing facilities as a whole.

The minority report also recommends that each territorial college shall undertake the training of secondary school teachers, provide refresher courses for the non-graduate teachers of existing secondary schools, as well as a two-year course, following the school certificate course, for training primary school teachers; and the teacher training section of each college should experiment in the training of women teachers. Other proposals for a balanced educational policy include vocational courses for training social workers, a clear distinction between the training of social welfare workers, undergraduate study and postgraduate study and research. It is suggested that the territorial colleges should also act as extra-mural centres of the West African University College, and that it would be of advantage if the research headquarters of the Institute of West African Arts, Industries and Social Science were situated at Ibadan, though experimental stations and local research units would be maintained by it in all territories. In addition to the schools of medicine, agriculture, forestry and animal health, the proposed Institute of Education and a West African School of Engineering should also be established at Ibadan. The responsibility of recommending the creation of further institutions of university rank in West Africa would fall on the Inter-University Council proposed by the Asquith Commission; but in general the minority report suggests that it will be best to establish wholly new institutions rather than to attempt to convert territorial into university colleges.

As already indicated, the ably argued conclusions of the minority of the Elliot Commission appear to be more in keeping with the trend of the Asquith Commission than those of their colleagues; but individually and collectively the four reports present the university ideal in a way that gives them permanent value. That ideal is seen in relation to the present needs of the Colonial territories, and on the whole the immediate action required is clearly delineated with a large measure of agreement. Equally unmistakable is the note of urgency which runs through all the reports. The importance of university education is never over-stressed: it is always seen as part of a balanced educational policy as a whole. But it is clear also that unless university development in West Africa and the West Indies and elsewhere is not undertaken as a matter of great urgency, progress to self-government and real partnership will be retarded; and further, the economic and social development of these areas, and the implementation of developments under the Colonial Development and Welfare Act and the discharge of our pledges to build up social and economic institutions and to develop natural resources in these territories, will be retarded. The proposals of these reports merit full and sympathetic consideration: they involve close co-operation with the universities of Great Britain, co-operation on which the former Secretary of State for the Colonies rightly laid stress as a two-way traffic enriching the home universities as much as it is to the advantage of the Colonial territories themselves.

THE EARLY HUMAN EMBRYO

Ourselves Unborn

An Embryologist's Essay on Man. By George W. Corner. (The Terry Lectures.) Pp. xiv+188+8 plates. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1944.) 20*s*. net.

ALTHOUGH the embryonic development of man is one of the most copiously described of natural processes, until a few years ago there were several gaps in the story so far as it was known. The gaps, moreover, occurred at the most crucial stage, right at the beginning. Until a decade or so ago, the earliest known human embryos presented the picture of a minute vesicle, covered in villi and buried within the thickness of the uterine wall, the body of the vesicle consisting of a spongy tissue containing two small cavities between which the embryo reposed in the form of a flat plate. It was hard to draw any convincing analogies between this structure and that of the presumably comparable stages of other mammalian embryos. The early human embryo seemed aberrant in almost all its features; few other mammalian embryos bury themselves in the uterine wall, and no others were known with a similar development of spongy tissue, which might be considered either endodermal or mesodermal.

Our state of ignorance about the structure and affinities of early human embryos was dependent, of course, primarily on the difficulty of obtaining material for study. The opportunity to search a human uterus for recently fertilized ova is not an everyday occurrence even in a large hospital, and when it does occur, the difficulty of finding the minute object is considerable. Specimens from man's nearer anatomical relatives, the monkeys and apes, should theoretically be easy to obtain by special breeding; but that, again, is a most expensive proceeding, much beyond the resources of most embryological institutes.

In recent years the financial difficulties have been overcome with the aid of the generous funds placed at the disposal of scientific workers in the United States, and the Carnegie Institution of Washington has bred a supply of embryos of the Rhesus monkey. These have been fully studied and the crucial early stages described by Heuser and Streeter and others. At the same time, by an organized search on an adequate scale, a considerable number of very young human embryos have been discovered and investigated at the same Institution. Dr. Corner, who has recently become the director of the Department of Embryology in charge of these studies, made them the subject of his recent Terry Lectures, which have now been published in book form. He has thereby provided an account, both authoritative and easy enough for even the layman to understand, of the most recent advances in this field of human biology.

The new human material, and the even more complete series of forms from the Rhesus, show clearly that man's development is by no means so extraordinary as it appeared. Although no free blastocyst has been found, the earliest known stages show that man passes through such a form in a more or less normal manner. We have material which illustrates the immediately following stage, in which the blastocyst first adheres to the uterine wall and then burrows within it; and the monkey material shows that in other Primates too a similar process occurs. The new specimens allow us to examine in much more detail the formation of the extra-embryonic spongy filling of the trophoblast, and although the process is by no means fully understood, and correct attribution of the tissue to mesoderm or endoderm still remains largely a matter of choice, it is at least certain that, in this process again, man is closely similar to the monkey and the ape.

Dr. Corner describes the most important features of man's early Primate embryology with great clarity, and illustrates them not only with simple diagrams, but also with some of the beautiful photographs which have been a feature of the publications of the Carnegie Institution. He is, perhaps, less successful in attempting to attach profound philosophical importance to these facts. The Terry Lectures are, of course, concerned with "building the truths of science and philosophy into the structure of a broadened and purified religion", and a lecturer on such a foundation is specifically invited to step, for once, beyond the narrow confines of a rigid adherence to immediate appearances, and encouraged to exhibit the broader implications of his subject. History, however, has flowed on beyond the controversies in which the facts of descriptive embryology were sharp and dangerous weapons, and it is not easy now to make their import seem momentous. "In the foregoing pages," writes Dr. Corner, "I have outlined the evidence for two very weighty conclusions about the physical nature of man. The first of these is that he is an animal, a member of the Class of Mammalia, Order of Primates, and closely related to the apes and monkeys. The second is that the human body is not notably endowed with specialized anatomical features. . . ." One may admit that the conclusions are weighty; but it is difficult not to feel that the first at least is a commonplace. Dr. Corner's material is, in fact, of first-class scientific importance, as solid, incontrovertible data filling in a gap in the scientific picture; the attempt to 'write it up' as of immediate import to man's spiritual life leads to the interpolation of occasional passages which some readers may find jarring.

C. H. WADDINGTON.

CLASSIFICATION OF RECENT PHILOSOPHY

Process and Polarity

By Prof. Wilmon Henry Sheldon. Pp. xvi+153. (New York: Columbia University Press; London: Oxford University Press, 1944.) 13*s.* 6*d.* net.

THIS, the first of the Woodbridge Memorial Lectures, is a fine tribute to an American thinker recently dead, by one who shares a great deal of his philosophy and even more of his eminently civilized and humane attitude, his wide sympathies and his felicity of exposition. Prof. Sheldon classifies what he considers the important tendencies of recent philosophical thought, though without despising or distorting them, so as to bring out their relationship with his own views. His view of the nature of the opposition between rival philosophies is that each describes a genuine and important aspect of the world or general tendency of things, while apt to neglect others. Philosophers are generally right in what they assert, but wrong so far as they deny the reality or importance of the neglected aspects. Thus 'idealism' expresses the aspirations and insight of men as moral agents; 'materialism' the basic facts of existence, which the idealist despises (perhaps rightly) but ignores to his cost. Older attempts to effect a synthesis of these two extremes he calls 'scholasticism'—a recognition of the reality of both material and ideal as each playing a complementary part in an eternal divinely ordered scheme; for the scholastic order is fixed, reality eternal and temporal process entirely subordinate. Many recent thinkers (including the author) attempt a synthesis in terms of process, incremental change or evolution. Prof. Sheldon includes also in his scheme mysticism and scepticism, which are opposed in another dimension, as it were; and distinguishes two divergent forms of idealism, monistic and pluralistic.

Prof. Sheldon is a pragmatist so far as he takes thought to be essentially that which issues in action and is thereby put to the test; but he avoids the errors that come from despising reflective thought and from taking a commercial view of the ends of action. His statement (p. 22) that the full development of mental process requires all three phases, cognitive, æsthetic and practical, could scarcely be bettered. If this exposition could be taken as a preliminary sketch and the classification of philosophies as schematic and limited to the purpose of defining his own view, there would be nothing to find fault with. But apparently it is intended to be complete. Other types of opposition in thought, excluded from the classification, are dismissed as unimportant, ingeniously but not convincingly. The classification covers best those recent minor thinkers who fit readily into 'schools', but scarcely any of the great thinkers. The Greeks do not fit in; nor do Descartes, Spinoza or Kant. Excessive use is made of the ambiguity of the terms 'idealism' and 'materialism'. The notion of progress as change in any determinate direction is turned too easily into that of change which meets with our moral approval. Lastly, there seems no reason why those who recognize the importance of temporal process or progress in any sense should agree on anything else. There is as much difference between Herbert Spencer, Bergson and Prof. Sheldon as between any three philosophers taken at random.

A. D. Ritchie.

THE ANIMAL IN HEALTH

Physiology of Farm Animals

By Dr. F. H. A. Marshall and E. T. Halnan. Third edition. Pp. xi+340. (Cambridge: At the University Press, 1945.) 18*s*. net.

While most text-books on animal physiology are written from the point of view of the treatment of diseased conditions, this book by Marshall and Halnan is exceptional in that its object is the teaching of physiology as a basis for the management of the animal for production, normal health and growth. Animal physiology forms the fundamental science on which the teaching in the breeding, feeding and management of farm animals should be based. In the past, teaching in this sphere has been almost entirely based on practical animal husbandry rather than on the basal science. The science of animal physiology should in the future stand in the same relation to animal production as the science of botany has in the past stood as a basis for teaching in crop production in agricultural colleges. With the increasing demand for knowledge in the field of applied science and with the present emphasis on the livestock side of British agriculture, the new edition of this book, which has been out of print for some time, should supply a need for agricultural students and others interested in farm animals.

Naturally the functions of nutrition, reproduction including milk secretion, growth and locomotion find a larger place than in most text-books of physiology. In this respect it more nearly resembles the text-books of physiology of some sixty years ago. The present edition has been thoroughly revised and includes the results of recent investigations, particularly in the fields of nutrition and reproduction. The chapters on the energy requirements of the body, metabolism of organic and ash constituents, and feeding standards include much useful information on the results of modern research and are presented in a clear and simple form. A chapter on digestion and other facts concerning the fowl, so frequently neglected in modern books on physiology, is included. Similarly, the chapters on the male generative organs, the female generative organs including the mammary gland, and growth give the essential facts elucidated by recent research in a form which can easily be grasped by the student.

In detailing these results the research worker's name is given, but one misses, however, a short list of references to outstanding papers, books and reviews of the subject, which would enable the reader to continue with advanced study in any particular aspect in which he might be interested. The large number of illustrations makes the book particularly suitable as an introduction to the subject for the agricultural and veterinary student.

John Hammond.

A TEXT-BOOK OF HEAT

A Text-Book of Heat

By G. R. Noakes. Pp. viii+469. (London: Macmillan and Co., Ltd., 1945.) 10*s*. 6*d*.

To his successful volumes on optics and on electricity and magnetism, Mr. Noakes now adds a comprehensive text-book on heat "up to scholarship standard". Instead of taking the material of the older books, correcting obvious errors and including new matter merely with the object of securing encyclopædic completeness, he has wisely chosen the more philosophic plan of examining critically current ideas on the subject, in order to present them in such a way that the young physicist may receive a sure grounding in fundamentals rather than make an acquaintance with an excessive range of isolated facts and opinions.

Guided by his wide teaching experience, the author has deemed it necessary to challenge much that has become almost sacrosanct by dint of uncritical repetition in the past. Thus, definitions have been examined and often found wanting in precision; experimental results have been reviewed as to their meaning and application and, with characteristic and commendable boldness, old and inaccurate methods of measurement (the only claim of which to value was the doubtful one of respect for teaching traditions) have been omitted or relegated to a mere note in favour of up-to-date working practice hitherto scarcely touched upon in text-books of this standard.

The treatment throughout is highly original and stimulating. Physics teachers will take special delight in the presentation of thermometry, calorimetry, kinetic theory of gases, transference of heat and thermodynamics. The chapters on low temperatures and heat processes in the atmosphere provide a valuable survey of recent research in fields that have become of great importance to everyday life; indeed the realistic outlook of the whole volume, coupled with its sound statement of fundamental principles, would seem to render it a fitting guide to the 'heat' section of the course for the new National Certificates in Applied Physics, and to this end it may be strongly recommended to technical teachers.

Practising physicists who desire a refresher course in classical physics will find the volume both entertaining and instructive, especially if they attempt some of the searching numerical examples provided for exercise.

A NEW COSMOGONY OF THE SOLAR SYSTEM

FULL details of a new theory of the origin of the planets have now reached Great Britain from Sweden in a series of papers published by Dr. Hannes Alfvén in the past three years. The main theory is given in two of these papers[1], though references are made in these to preliminary work appearing in other Swedish periodicals.

Previous cosmogonies of the planetary system have started with some premise (more or less likely according to the state of knowledge at the time) as to the original spatial distribution, velocity and physical condition of the matter later to form the solar system, and of any neighbouring material required by the theory. The subsequent history of the matter is then decided by calculating the gravitational and other mechanical interactions involved, using the accelerations thus deduced to predict for the present time a new spatial distribution which should, of course, approximate to the present state of affairs. Dr. Alfvén breaks new ground by considering not merely the gravitational but also the electromagnetic interactions. Ions and electrons within the planetary system, he claims, are affected very much more by the sun's general magnetic field than by its gravitational field; and since at the time of genesis of the system the planetary matter is likely to have been at least partially ionized, it is probable that electromagnetic forces have been more important than mechanical forces in shaping the system as we see it to-day. From a study of the motion of ions in the solar magnetic field, he is led to attribute the formation of the planets to the passage of the sun through an interstellar cloud or series of clouds—a circumstance which, incidentally, is not so intrinsically unlikely as the close approach of another star required by theories of the 'catastrophic' type. Alfvén claims that in these conditions matter will accumulate in the equatorial plane at about that distance from the sun at which the present major planets are found. From this starting point he is able to explain many features of the solar system, even down to such details as why Saturn alone has rings, and why the rings show their observed structure.

It is relevant to recall here that the main difficulty encountered by cosmogonies of the Laplace type—the nebular hypothesis and its many modifications—concerns the peculiar distribution of angular momentum among the bodies of the solar system. A uniform discoidal nebula contracting from planetary distances would result in a system in which the main angular momentum was possessed by the central body, and no appeal to the effect of viscosity in redistributing it has yet convinced astronomers that this agency can convey 98 per cent of the momentum from the sun to the planets. On the other hand, a strongly condensed nebula of which the outer portions contain initially only enough mass to make the planets cannot in fact form planets at all. The tidal theory in its many forms also suffers from this difficulty. The encounter between the sun and a passing star postulated on this theory must be sufficiently close for tidal eruptions to eject enough planetary matter to form the solar system. But, as Russell has pointed out, it is then impossible (by a factor of the order of ten) for the planets to obtain their angular momentum at the intruder's expense. Furthermore, there is as yet no agreement as to the form taken by the filament of matter tidally extracted, or even whether it will dissipate or condense. The other time-honoured objection to tidal theories is the low probability of a close encounter. Now it is not a valid objection to an encounter theory that encounters are improbable: they may nevertheless happen, and all the objectors can justifiably claim is that planetary systems will be correspondingly rare. The discovery of non-solar planets[2] militates against this view. It is perhaps not an unfair summary of the present situation to say that those hypotheses which can claim an end-product most like the present solar system are precisely those which introduce the greatest number of *ad hoc* assumptions. Clearly, this is an unsatisfactory state of affairs.

In these circumstances, Dr. Alfvén roundly asserts that at the genesis of the solar system some kind of force must have been in action which is not taken into account in present theories. He believes that this force is the action of the general magnetic field of the sun on charged particles of primeval matter in motion in the solar neighbourhood, and his theory is an elaboration of this assumption.

In a preliminary paper[3], Alfvén has given reasons for believing that if a cloud of ionized gas invades the magnetic field of a rotating electrically conducting sphere, currents will be induced in the gas which will interact with the magnetic field so as to accelerate the ion cloud and retard the rotation of the sphere, thus tending to equalize the angular velocities. Applying this to the solar rotation, he comes to the conclusion that the time needed for this process (approximately 10^6 years) is very much smaller than the currently accepted age of the solar system, and thus that the transfer of angular momentum by this means is worthy of consideration. A further point of interest is that the rate of retardation is expected to increase with heliographic latitude, so that the non-uniform rotation of the sun observed at present may be due to this braking process in a past so distant that the planets have had time to form and acquire most of the original angular momentum, yet not so distant that solar viscosity has been able to equalize the solar rotation in all latitudes.

The theory starts, then, with the sun a single star in much the same condition as at present, save for a faster rotation. At the outset it enters a gaseous nebula consisting of neutral atoms with peculiar velocities corresponding to the temperature of interstellar space. These atoms begin to fall in under the sun's gravitational field, exchanging their potential energy for kinetic. At a distance r from the sun, the kinetic energy of an atom produced by gravitational attraction is

$$E = GM_{\odot}Am_H/r,$$

where G is the constant of gravitation, $M_{\odot}$ the sun's mass, A the chemical atomic weight, and m_H the mass of unit atomic weight. Mutual collisions between the atoms will result in a rising 'temperature' corresponding to this kinetic energy as r decreases; this process is similar to the heating by gravitational contraction suggested nearly a century ago by Helmholtz as the energy-producing mechanism in the sun. At a distance r_i from the sun, which depends on the atoms concerned, this energy becomes equal to the ionization energy eV (where V is the ionization potential). At this distance,

$$r_i = GM_{\odot}Am_H/eV,$$

the gas becomes ionized. Thence the system of forces is completely transformed. Electromagnetic forces come into play which are usually larger than the gravitational attraction, and the ions are repelled, spiralling away from the sun around the magnetic lines of force. Meanwhile, the process mentioned above begins to cause rotation about the sun's axis. A neutral gas falling into the sun from interstellar space is thus stopped at about the distance r_i from the sun. It is obviously interesting to calculate this distance for a hypothetical material. If $A = 7$ and $V = 12$ volts (values not unreasonable for planetary material) r_i is found to be 8×10^{13} cm., a value close to the radius of Jupiter's orbit. This is, of course, a drastic schematization of the actual conditions, for different atoms will be stopped at different critical distances; but it does serve to indicate that a gas cloud will tend to accumulate at about the distance from the sun of the major planets.

Atoms which become ionized on the spherical surface r_i can move only on the surfaces engendered by rotating the magnetic lines of force around the axis of the sun[4], for on account of their low kinetic energies they are constrained to perform close spirals around the lines of force, while rotating also about the solar dipole. Alfvén shows that, so far as its average trajectory is concerned, each particle may be replaced by an 'equivalent magnet' of moment

$$\mu = A m_H v^2 / 2H,$$

where v is the velocity of motion perpendicular to the line of force and H is the local field strength. This equivalent magnet is acted upon by a force $-\mu \operatorname{grad} H$ due to the non-uniform field, the minus sign indicating a repulsion down the magnetic gradient. For a given particle, stable equilibrium is possible only where its line of force cuts the equatorial plane; so that from the initial spherical shell of constant density the ions move to the equatorial plane, building up a disk of variable density by projection along the lines of force. Alfvén calculates the density distribution to be expected, and by assuming that all the material between the radius r_i and the orbital radius of Saturn has condensed into Jupiter, and all that between the orbits of Saturn and Uranus has condensed into Saturn, and so on, he obtains the following relative masses to be expected for the outer planets:

	Mass (Earth = 1)	
	Calculated	Observed
Jupiter	(317)	317
Saturn	87	95
Uranus	26	15
Neptune	10	17

The condensation process he invokes is one suggested by Lindblad[5], which depends on sublimation due to the great difference of temperature between the interstellar gas and solid particles. The process is favoured in the relatively dense accumulation in the equatorial disk, and may possibly occur after recombination of the ions in that neighbourhood. After recombination, only gravitation affects the particles, which then revolve in orbits of eccentricity 1/3 with their accrued angular momentum. Collisions then transform these orbits into a circle of radius equal to 2/3 of the distance at which recombination occurred, a fact which Alfvén later uses to explain much of the detailed structure of Saturn's rings and the asteroids.

The agreement in order of magnitude shown in the table above encourages an attempt to apply the same reasoning to the planetary satellites. If after formation of the outer planets some of the gas cloud remains uncondensed, and if the newly formed planets become magnetic dipoles, the process is likely to recur on a smaller scale. The residual gas will be attracted by the gravitational fields of the planets, will fall in towards the parent bodies and become heated, ionized and then stopped at certain critical distances by the magnetic fields. It is significant that in the case of Jupiter this critical distance is of the same order as the orbital radii of the Galilean satellites. With Saturn the critical distance is within the Roche limit, so that the material which would otherwise form the first satellite (the analogue of Jupiter in the solar system or of Io in the Jupiter system) cannot condense at all and forms the spectacular ring system. With Uranus and Neptune the mass is so small that the critical radius is of the order of that of the planet itself, so that neither satellites nor rings would be expected as a result of the primary process.

The theory thus accounts qualitatively and even, in some respects, quantitatively, for the observed mass distribution in the outer planets and their inner satellites—the first family, as Alfvén calls them. There remains the question of the second family: the terrestrial planets and the outer satellites of the outer planets. It is possible that the latter are the result of the primary process acting on those constituents of the interplanetary nebula which have high atomic weights or low ionization potentials (or both). It is sufficient to make $A = 30$ and $V = 9$ volts to get numerical agreement between the theory and observation. In this connexion it is satisfactory to note that the densities of the outer satellites of Saturn are considerably higher than those of bodies in the first family, whether planets or satellites. But to explain the formation of the inner planets on the theory as given above is impossible. Even for hydrogen, $A = 1$ and $V = 13{\cdot}5$ volts, giving $r_i = 10^{13}$ cm., so that penetration inside the orbit of Venus is impossible. At best, Mercury would be non-existent and Venus a mass of pure hydrogen!

As a working hypothesis offering a way out of this difficulty and accounting simultaneously for both the planets and the satellites of the second family, Alfvén suggests that the primeval material from which the inner planets were formed consisted of solid particles resembling meteoric dust. These can penetrate much closer to the sun than atoms: for unlike gas ions, dust particles will be practically unaffected by the general magnetic field, which will take effect only when the particles are near enough to be partly volatilized. If volatilization and ionization occur in the region of the inner planets, the ions will be repelled at once along the inner lines of force and will accumulate in the equatorial plane and start rotating exactly as in the formation of the first family. Hence the terrestrial planets. A small proportion approaching the sun's poles will be repelled as far as the outer planets and on recombination will form satellites distinguished from those previously considered by the high value of A/V characteristic of meteoric matter, and thus by larger values of r_i than first-family members. Alfvén identifies this family with the outer moons of Jupiter and Saturn and the satellites of Uranus and Neptune. For $A/V \sim 5$ volt^{-1} the critical distances r_i are of the right order; and this value is not unlikely if meteorites reaching the earth are typical in their chemical composition (oxygen, 1·2; iron, 7·2; silicon, 3·5; magnesium, 3·2).

Further development of the theory enables Alfvén to explain in some detail certain features exhibited in the densities and axial rotations of the planets and their satellites; but enough will have been said here to give the broad principles of the theory he has advanced. Two circumstances militate against its widespread acceptance at present. First (and this applies to any cosmogony) the nature of the problem is such that any theory must be developed from premises which are largely guesswork, and can have few points at which direct observational checks can be applied. Second, during the past six years international exchange of scientific periodicals has been in so chaotic a condition, and so few astronomers have been free to conduct abstract studies, that much potential criticism has yet to be formulated. The end of the War in Europe will, no doubt, quickly remedy matters in respect of this second point, but the first will remain. Alfvén's hypothesis cannot hope to escape the criticism which has been so freely bestowed upon its predecessors. For example, its very basis, that the sun possesses a general magnetic field, has in another connexion been challenged from the observational point of view[6]. Furthermore, calculation of the trajectories of charged particles in non-uniform fields is not an elementary matter, and Alfvén's treatment of the problem may be attacked. But he will have performed a valuable service to astronomy if this series of papers can establish that electromagnetic forces have in the early stages of the solar system played a part even comparable with those mechanical forces which have hitherto been the only ones considered. A. HUNTER.

[1] Alfvén, H., *Stockholm Obs. Ann.*, 14, No. 2 (1942); No. 5 (1943).
[2] Hunter, A., *Nature*, 152, 66 (1943).
[3] Alfvén, H., *Ark. Mat. Astr. Fys.*, 28, A, No. 6 (1942).
[4] Alfvén, H., *Ark. Mat. Astr. Fys.*, 27, A, No. 22 (1940).
[5] Lindblad, B., *Nature*, 135, 133 (1935).
[6] Evershed, J., *Mon. Not. Roy. Ast. Soc.*, 99, 430 (1939).

THE SCAPEGOAT IN MODERN EUROPE

IN view of the important and unhappy part played by scapegoats in the political field in recent years, the general theme of the scapegoat in modern Europe was a well-chosen one for a joint meeting of the Royal Anthropological Institute and the Social Psychology Section of the British Psychological Society held in the rooms of the Institute on July 3, Prof. Daryll Forde being in the chair. It was perhaps unfortunate that most of the speakers allowed themselves great latitude in the interpretation of the subject, with the result that less light was thrown upon contemporary aspects of scapegoatism than might have been hoped for. Nevertheless, the great significance of the theme in human history and culture was well illustrated by the discussion, as was also the amazingly wide range of social phenomena in which it may play a part.

Dr. J. C. Flugel, in opening the discussion, outlined his view regarding the general nature of the psychological processes involved. The use of scapegoats involves the general process of 'displacement', 'substitution' or 'deflexion', that is, the transference of an impulse from one object to another in virtue of association or conditioning, the particular kind of displacement here involved being the projection of aggression, guilt or suffering. It is theoretically possible to distinguish between the transference of simple misfortune (for example, barrenness or disease) and of guilt; but in practice the distinction is often difficult, since misfortune is often regarded as itself in the nature of a punishment for guilt, and the use of a scapegoat is then only a means of shifting the burden of punishment. In the view of many psychologists, the spirits or demons that in primitive beliefs are responsible for so many human disasters are themselves mental creations due to the projection of human aggressiveness, which in this form recoils on those in whom the aggressiveness originated.

A full psychological understanding of scapegoatism thus necessitates a consideration both of projection and of the role of punishment. Projection (the attribution to others of qualities in ourselves) arises from, and in some sense perpetuates, the confusion between the self and not-self to which child psychologists have directed attention, a confusion to which in some measure we return as we fall asleep or dream and which can even be experimentally induced by the adoption of certain attitudes (as in Spearman's interesting 'experiments in objectivating'). Projection is also due in part to the general tendency to establish the equation: 'good'=self, 'bad'=not-self. The child soon discovers that what is 'bad', that is, painful, disturbing and (later) 'naughty', can often be dealt with either by destroying the 'bad' outer object or removing himself from it, whereas when the 'bad' is within the self, either in the form of unpleasant bodily sensations or mental uneasiness or guilt, there is no such possibility; hence there arises a natural desire (in virtue of a primitive form of 'wishful thinking') to place everything that is 'bad' in the category of the not-self. Projection is complementary to introjection (the attribution to the self of qualities of persons or things in the outer world) and the child-analysts consider that the two processes —one following the other in long alternating sequence —play an important part in mental development. Projection is also allied to such processes as these in virtue of which a man identifies himself with his children, family, possessions or country (W. James's 'extracorporeal' or 'social-selves') or finds a vicarious satisfaction in the triumphs or enjoyments of others (Anna Freud's 'altruistic surrender'). The projection of aggression in a form relevant to the theme of scapegoatism is clearly seen in many childish phobias, where the bogies feared (for example, fierce animals or ogres) owe their terrifying qualities to the child's own aggressive impulses. There is good reason to suppose that the psychological process here is fundamentally similar to that involved in the alarming features of the primitive animistic beliefs in demons and evil spirits already referred to. Projection of the same kind is also at work in delusions of persecution or jealousy, where the patient's own 'evil' wishes are attributed to the supposed persecutors.

Turning to punishment, Dr. Flugel said that this is a fundamental method of dealing with guilt. There is in the human mind a deep tendency to expect, and indeed to demand, that guilt should be atoned for by punishment, though in virtue of projection the punishment can sometimes be suffered vicariously by a scapegoat. Some persons are more inclined to blame, and inflict punishment on themselves, others to project the blame and inflict vicarious punishment. On the basis of recent experimental studies, these have been called by Rosenzweig the 'intro-punitive' and 'extra-punitive' types respectively. Minor forms of scapegoatism can be seen in children's play and fantasy, where dolls or 'imaginary companions' can get into scrapes and receive appropriate punishment of a kind which may previously have befallen the children themselves; the 'bad' impulses are here projected on to the toys or fantasy-figures. In adult life the same tendencies may manifest themselves in scandal-mongering, in purity campaigns, in our attitude to criminals and in educational practice. In all these cases the persons blamed or punished are guilty of actions to which we ourselves are to some extent tempted, and in administering censure or punishment on the scapegoats, we are also putting things right with our own conscience. A great advantage of the use of scapegoats is that we can feel virtuous ourselves. In the field of religion there is the important category of divine scapegoats who are sacrificed to atone for guilt. It is at first sight strange and paradoxical that so many sacrifices *to* a god are also sacrifices *of* that god (in direct or symbolic form). A further but connected problem is raised by the fact that in these cases the scapegoat is 'good'. The solution of both problems is probably to be found in the existence of 'ambivalence' on the lines indicated by Freud in his theory of totemism.

Finally, there is the class of political scapegoats who have played so great a part in recent years. Hitler, in accusing the Jews of seeking world dominion, was, of course, projecting on to them his own desires, and in so doing succeeded in making the Nazi designs appear supremely righteous to himself and his followers. Quite generally, the use of political scapegoats is a potent means of disposing of the aggressive impulses in the members of a group without disrupting the group. Indeed, by attributing every kind of evil design to the scapegoat and thus apparently necessitating a united front against him, this psychological device can greatly increase the internal cohesion of the group. Hence the great and sinister role taken by the scapegoat motif in inter-group conflict throughout human history.

Dr. M. A. Murray, who was the second speaker, confined herself to two main themes: the relation of the scapegoat motif with fertility, and its manifestation in the death of political scapegoats during a certain period of English history (from Edward I to the end of the Stuarts). Scapegoats, she suggested, were found only in agricultural, not among pastoral, peoples. There are at bottom three origins of the idea of the scapegoat: (1) Sin causes barrenness of the soil; in order to avoid this calamity the sins of the community are laid on one person, who is killed or driven out. (2) The spirit of fertility becomes incarnate in a man (the 'god-box'). If this man grows weak or dies, fertility will diminish or disappear; therefore the 'god-box' must be killed with due ceremony while still strong, and the spirit put into a young and lusty 'god-box'. (3) Life is taken out of the ground by the crops, therefore life must be given back to the ground. This can be done by pouring the blood of the victim on the ground, by burning him and strewing his ashes on the ground, and by asphyxiation, when the body is dismembered, the pieces of his flesh being distributed over the land (connected with the custom of drawing—in the sense of disembowelling—and quartering the body of a traitor or criminal).

The spirit of fertility is most naturally incarnated in the person of the king or ruler—for whom, however, a substitute or scapegoat can be found. (A relic of this is to be found in the English coronation ceremony at the moment when the king, after the anointing, stands alone divested of his outer robes and clad in white, while those officiating step away from him.) In the course of time this whole process is apt to become stylized and connected with certain cycles (mostly seven- or nine-year cycles), the origin of which is still far from clear, though there is no doubt it is of great antiquity. The sacrificial months of the Old Religion (which Dr. Murray calls the 'Dianic cult') were February, May, August and November. The right days for the sacrifice were February 2, May 1, August 1 and November 1, though these were not always observed when the custom began to die out. The periodic sacrifice most marked in English history is that of the seven-year cycle. The victim was slain when the king's age had reached a multiple of seven years (personal victim), or when his reign had reached seven or a multiple of seven years (regnal victim). Among notable victims might be quoted:

William Wallace, Mock King. Executed August 23. Edward I's age, twenty-one.

Piers Gaveston, Mock King. Surrendered to the barons on condition that no harm should happen to him until August 1. Beheaded. Edward II's age, twenty-eight.

Duke of Clarence. Murdered (in a butt of malmsey ?) February 18. Edward IV's age, thirty-five.

Perkin Warbeck, Pretender to the throne. Executed November 23. Henry VII's age, forty-two; reign, fourteen.

Cardinal Wolsey. Died November 29. Henry VIII's reign, twenty-one.

Dr. Murray suggested that the fact that there was always a victim in England upon whom the people could vent their sense of guilt at periodic intervals may be a cause of the tolerance which is so marked a feature of the English as compared with most other nations.

Further to the subject of national differences, Dr. Margaret Loewenfeld, in opening the general discussion, remarked on the differences in the attitude of various cultures to the expression of feeling. Although in Britain emotion is often considered disreputable, members of other cultures (for example, in their different ways France and Germany) might feel they have a right to certain emotional experiences (such as that implied in 'thinking with the blood'). In such circumstances those who do not feel in the same way become an out-group, and in time of frustration it is inevitable that the out-group should become a scapegoat. She illustrated this by reference to the Suffragette movement and the attitude of members of the Stock Exchange to 'bucket shops'.

Dr. Ernest Jones emphasized the importance of distinguishing between scapegoatism and simple aggression. The Nazi use of the Jews as scapegoats probably depended largely on the fact that Germans were at bottom disturbed by the imputation of war guilt; but instead of resorting to sackcloth and ashes (as the ancient Hebrews might have done) they projected their guilt. We may, he said, never have another such opportunity of studying scapegoatism on the grand scale, and he was disappointed that the discussion had not dealt more in detail with recent events. He suggested further that the Germans did not look for scapegoats so much among their foreign enemies as among themselves, and found them among their own Jews and Communists. This may be connected with the fact that, as psycho-analysis has shown, the child builds up an idea of good or bad 'internal objects'. In answer to a question, he admitted the feeling against international Jewry, but he thought this might be only because there are German (or English, etc.) Jews.

The distinction between guilt and simple aggression was further brought out in the remainder of the discussion, which dealt, among other things, with the guilt feelings of Britons and Americans at not being adequately prepared for Nazi or Japanese aggression, with the fact that the chosen scapegoat need not necessarily be innocent as judged by rational standards, and with the possible existence of rudimentary guilt and scapegoatism in animals.

THE ATOMIC BOMB

A PAMPHLET, "Statements relating to the Atomic Bomb", published by H.M. Stationery Office (price 4*d.* net), gives some account of the activity in Great Britain and the United States leading to the use of this weapon in Japan by the United States Army Air Force. Reference is made to statements issued by the United States and Canadian Governments giving an account of the work carried out in these countries which led up to or was associated with the achievement, and an outline of the scientific background. The statement includes a brief summary of earlier work on nuclear disintegration which bears only indirectly on the phenomenon of nuclear fission, on which the activity of the atomic bomb depends, and then gives some account of the work on the fission of uranium nuclei, published prior to the beginning of the War, and the development of which on a large scale led to the atomic bomb.

In 1934 Fermi and his colleagues in Rome subjected uranium to neutron bombardment and showed that new isotopes were formed which were radioactive, and it was thought that atoms of atomic number higher than 92, that of uranium, had been produced. These elements were not known in Nature. In 1938–39, however, Hahn and Strassmann, in Berlin, made experiments which showed that one, at least, of the new isotopes believed to be of higher atomic number and mass than those of uranium was really an isotope of barium, which had an atomic number and mass about half that of uranium. Frisch and Meitner thereupon pointed out that a phenomenon which they called 'nuclear fission' had occurred, the uranium nucleus being split into two parts of roughly equal mass, and that the two parts of the divided uranium nucleus should fly apart with great energy, a prediction verified experimentally by Frisch in Copenhagen. Confirmation of this fission process, and of the great liberation of energy, was independently obtained by Joliot in Paris, and by many other physicists.

Early in 1939, Joliot, Halban and Kowarski proved experimentally what had been predicted theoretically, that in the fission of uranium, a number of free neutrons were also produced, and independent confirmation was obtained by Anderson, Fermi, Hanstein, Szilard and Zinn in the United States. It was clear that the fission not only provided a large amount of energy by reason of the loss of total mass which had occurred, according to Einstein's theory of the correlation of mass and energy, but also that the liberation of neutrons in the process, which was produced by neutron bombardment, suggested that each time a uranium nucleus underwent fission, the reaction might be accelerated by the neutrons which it itself produced. It would, in fact, be analogous in the field of nuclear chemistry to the well-known chain reactions in the chemistry of stable atoms and molecules. The process could be started by the application of only a minute fraction of the energy which would ultimately be liberated.

Bohr and Wheeler had published a theory of the fission process in 1939 in which it appeared that the isotope of mass 235, present in only small amount in natural uranium, which consists mostly of the isotope of mass 238, should undergo fission particularly easily when the bombarding neutrons had a very low energy, whereas the isotope of mass 238 requires high-energy neutrons. This prediction was verified in 1940 by Nier, and by Booth, Dunning and Grosse, in the United States. Neutrons of an intermediate energy-range are strongly absorbed by the uranium 238 nucleus; but instead of producing fission, a new nucleus of mass 239 is formed. This has the property of emitting two electrons in succession, thus forming nuclei of atomic numbers 93 and 94, which do not occur in Nature. The nucleus of atomic number 94 should be capable of undergoing fission with the greatest ease when bombarded with neutrons of very low energy. The elements of mass 235, 238 and 239 are not the only ones which should undergo fission; thorium should undergo fission with bombarding neutrons of very high energy, and protactinium (mass 231, atomic number 91) should behave in a way intermediate between uranium 235 and 238.

The energy liberated in uranium fission is stated to be millions of times greater than that set free in the combustion of an equal weight of oil or coal; but the process must obviously be controlled, and a suitable 'slowing-down' medium is necessary, so that fast neutrons produced by fission would lose their energy by elastic collisions before producing further fission. Such a medium is provided by heavy water, or deuterium oxide. In an atomic bomb a quantity of uranium 235 greater than a certain critical amount is necessary. This is because the reaction depends on the conservation of the neutrons produced by the fissions. In a block of uranium, the proportion of neutrons which escape into the outer air, and thus become ineffective, is reduced by increasing the size of the block, and explosion is possible only with a certain minimum amount of material. Quantities less than this are perfectly safe. Thus, it is only necessary to bring together two pieces each less than the critical size, but exceeding it when in contact, to detonate the bomb. It is stated that the temperature of the mass then reaches many million degrees and the pressure many millions of atmospheres. The reaction must develop so rapidly that a substantial part of the material can react before the system has time to fly apart, and the neutrons produced in the fission process are fast enough to fulfil this condition, unless they are slowed down by artificial means.

Details are given of work at Liverpool and Cambridge on the dimensions of the bomb and related problems, and on the method of separation of the uranium 235 isotope by a gaseous diffusion method at Oxford and Birmingham. During this period, similar problems were occupying American scientific men. In 1942, it is stated, it became clear that the scale upon which research and development could be undertaken in the United Kingdom must be far smaller than in America. In 1943 a large research establishment was set up in Montreal, Canada, and in 1944 a British-Canadian-American project was in operation near Petawawa, Ontario.

The report gives the constitution of many committees set up, and of Government actions at various stages, and is a record of well-co-ordinated and actively prosecuted effort in the many directions necessary before the atomic bomb became a reality.

ARCHIVES OF THE LAKES

WE are just now being made aware that there exists a remarkable series of records of the history of Europe throughout the whole period since the great ice sheets began to release their hold on the Continent. These records are entombed in the deposits of our lake basins. We have hitherto been unable to read these archives; but the methods of pollen-analysis have given us the clue to their broad interpretation, and the story of forest history, of climatic change, and of human activity is discerned with increasing clarity. We have learned from de Geer that these records can, in some circumstances, be accurately dated; the lake deposits sometimes indeed consist of leaves, one page laid down per year, so that a precise geochronology of the past ten thousand years or so has been placed in the hands of the archivist.

A glimpse of the remarkable wealth of information such records may disclose is afforded by the recently published work of Max Welten on the deposits of a single tiny filled-up lake basin in the Simmental in the western Bernese Oberland[1]. This *Faulenseemoos* lies at a height of 590 m. above sea-level, on the road between Spiez and Interlaken, and here M. Welten, a pupil of Dr. Lüdi in Zurich, has carried out co-ordinated research on pollen-analysis, stratigraphy, and geochronology. Twelve detailed pollen-diagrams, distributed along a profile of the lakelet's length, which is only about 500 m., give a complex but consistent picture of the vegetational history of the region round the lake, which has been steadily filling in throughout post-glacial and late-glacial times. The lake was oligotrophic only for a short while, and then rapid infilling took place from land surfaces laid bare by the glacial retreat. With complete vegetational cover of the countryside, however, the infilling became slower. Heavy deposits of lake chalk were made round the shallow margins while the deep centre deposits grew very slowly, and then, as the climate grew warmer, organic material formed too rapidly for total oxidation aud nekron-mud (*gyttja*) was laid down. Thence followed a yearly periodicity of chalk deposition caused by influx of mineral-rich water in early summer, and of nekron-mud in autumn and early winter. Thanks to the small size and shelter of the lake, these annual layers were preserved in long series, and have permitted the construction of a geochronology which reaches to the present day. In terms of this all other stratigraphic, climatic and vegetational events have been dated. More also than this: the recognition of annual layering has permitted Welten to express his results in terms of absolute rates of pollen deposition per unit area of lake surface. He has thus provided the test we have long awaited, of the validity of the standards of reckoning, long accepted *faute de mieux*, such as grains per cent of the total tree pollen, or grains per unit area of microscopic preparation.

There has always hitherto been much room for doubt how far the parallel and analogous changes in forest history in the Alps and in regions far afield were indeed synchronous, but Welten's new chronology goes far to set such doubts at rest. His date of 5400 B.C. for the sudden extension of the mixed oak forest in *Faulenseemoos* corresponds closely with that given by Fromm for the equivalent vegetational change in Ångermannland. Confirmation of Welten's own chronological series comes from such results as the estimated age of the end of the Neolithic period at 1800 B.C., a close agreement with archæological estimates.

From the relative and absolute amounts of the lake chalk, organic mud and mineral matter, Welten is able to deduce climatic conditions, as also from the vegetational changes recorded by the pollen analyses. The regional vegetational history begins with the early dwarf-willow stages when the soil was open to erosion; the middle dwarf-willow – grass stages with closed ground cover and abundant *Helianthemum alpestre*; the third willow stage with extension of the dwarf-birch and entry of the tree birches. Continued climatic improvement then led to an explosive but temporary expansion of the sea-buckthorn (*Hippophaë rhamnoides*) in conditions of slight competition, and then to successive phases of dominance by *Betula pubescens* and *B. verrucosa*. About 6150 B.C. a climatic retrogression broke the trend of general amelioration, but thereafter the open pine woods were rapidly succeeded by hazel scrub, and afterwards by mixed oak forest. About 3200 B.C. beech became dominant, and thereafter persisted, in varying relation to the spruce and mixed oak forest, as an important forest component to the present day. Early human activity is reflected in the diagrams not only by changes in the pollen frequency, but by the appearance of cereal pollen, by increase in mineral deposition in the lake, and by the pollen of such introduced trees as the walnut. These elaborate and exactly dated diagrams will be of the utmost value to the study of quaternary history in central and southern Europe, and the work as a whole deserves our own attention and emulation.

Such studies as this show the manifold indexes by which the deposits of former lakes may be made to yield the secrets of their history, and of the vegetational changes which they and the surrounding areas have suffered through the long period since the Ice Age. Apart from its own great intrinsic interest, such knowledge affects biological and climatic issues of great and general importance, and constitutes a background essential to our attempts to understand the meaning of present vegetational types and present vegetational processes of lake biology. It is very much in the interest of British biology that means should be found to pursue such studies as these in our own lake basins, where at least equally rich rewards may be expected. Let us appoint and train these archivists.

H. GODWIN.

[1] Pollenanalytische, stratigraphische und geochronologische Untersuchungen aus dem Faulenseemoos bei Spiez. Von Max Welten. (Veroffentlichungen des Geobotanischen Institutes Rübel in Zürich.) Heft 21. Pp. 201. (Bern: Hans Huber, 1944.) 12.50 Schw francs.

OBITUARIES

Dr. Alexander Sand, F.R.S.

IN the completely unforeseen death of Alexander Sand at the age of forty-three, comparative physiology suffered a very severe loss. Not only was his later work distinguished in a remarkable degree, but so much more of the same calibre might have been expected from him in the next twenty years.

Sand's early work dealt with changes in electrical resistance accompanying the death of cells, and with the relation of combined nitrogen to the physiological activity of *Azotobacter*. After his appointment as lecturer in zoology at Capetown under Hogben, he undertook a series of experimental studies dealing with invertebrates, the first of which described the relation of electrolytes to the cardiac rhythm of *Jasus* and *Octopus*, the others the respiratory exchange of certain arthropods (a crab and a scorpion) and of a marine worm (*Bispira*). This work was accompanied by determinations which were made by Sand of the hydrogen-ion concentration and oxygen-content of samples of sea water, in connexion with studies undertaken by colleagues. His next work concerned chamæleons. After a peculiarly neat and illuminating paper describing adequately, for the first time, the mechanism of the projection of the chamæleon's tongue (1933), he published another important paper describing the bionomics and physiology of the pigmentary activity of this animal. These papers were followed by a contribution to *Biological Reviews* on the comparative physiology of colour-response in reptiles and fishes.

After Sand's return from Cape Town to England he was appointed physiologist to the Marine Biological Laboratory at Plymouth, and thenceforward his interests were devoted to experiments on fishes, dealing primarily with certain of their sense organs. He published in 1936, in collaboration with James Gray, papers on the locomotory rhythm and spinal reflexes of the dogfish. After a preparatory period, during which he mastered the complex and delicate apparatus required, Sand attained the height of his ability and began his final work on the sense organs. This work, carried out partly in collaboration with Otto Löwenstein, involved a series of precise and beautiful experiments, and resulted in a most marked and definite advance in our knowledge not only of the labyrinth of fishes, but also of the lateral sense organs and of the peculiar ampullæ of Lorenzini. It is this last body of work for which Sand will be longest remembered, and which entitles him to rank high among British comparative physiologists. He was elected to the Royal Society in 1944. Two of his collaborators, Gray and Löwenstein, have already been mentioned; but during his whole career Sand also published joint papers with Lancelot Hogben, Enid Charles and others.

One of Sand's outstanding characteristics, the precision of his use of experimental apparatus, came out not only in his research work but also in his teaching. During his years at Cape Town he conducted a class in comparative physiology which was distinguished by its finished and flawless demonstrations. Sand served in the Royal Navy during the Second World War, and died on July 11, 1945. His death has come as a great shock to his many friends.

T. A. STEPHENSON.

Prof. Ludwik Wertenstein

THE tragic death of Prof. Ludwik Wertenstein, who was killed in January during the battle for Budapest, deprives Poland of one of its leading men of science, and represents a grievous loss to physicists generally, among whom he had many personal friends.

Born in Warsaw in 1885, Wertenstein received his early education there and entered the University, which he had, however, to leave in 1906, after one year of study, because of taking part in the students' protest strike against the policy of the Tzarist regime. He went to Paris, where he entered the Sorbonne and began to work in Madame Curie's laboratory. His first scientific work was published in 1909 and was soon followed by a series of papers dealing mainly with the properties of recoil atoms of radioactive elements, a subject which, with his usual thoroughness, he pursued and studied for many years. He measured the range, ionization and charge of recoil atoms, and some conclusions of these experiments were recently confirmed in the study of the ionizing properties of fission fragments.

In 1913, the Scientific Society of Warsaw founded, under the auspices of Madame Curie, the Radiological Laboratory, where research work on radioactivity was to be centred. Madame Curie sent her two most outstanding pupils, Danysz and Wertenstein, to Warsaw to direct the work there. After the death of Danysz in 1914, Wertenstein became director of the Laboratory, and he remained there until its destruction in 1939. In 1919 he was appointed to the chair of radioactivity at the Free University of Poland, where he later founded the Laboratory of Atomic Physics. Except for the period 1925–26, which he spent at the Cavendish Laboratory under the late Lord Rutherford, all his scientific work was done in these two laboratories. Despite the constant difficulties and limitations due to lack of funds, he managed to create a centre of research which gained a high reputation abroad, and to form a school from which came a number of young men of science of standing.

Most of Wertenstein's scientific work was in the field of radioactivity; he made a detailed study of the properties of radon, found new methods for its purification, investigated its condensation properties, measured its vapour pressure and ionization potential, and determined the volume of one curie, an important quantity in radioactivity. But his interests embraced many other branches of physics, and among the large number of papers he published are some on such divergent subjects as vacuum technique, photochemical law and isotope separation. In recent years, he concentrated mainly on nuclear physics, in particular on problems of inelastic scattering of neutrons, photonuclear effects and fission. His last paper, on gaseous fission products, published in *Nature* of December 29, 1939, was sent out of Poland when it was already occupied by the Germans.

Apart from pure scientific work, Wertenstein took an active part in the organization and popularization of science in Poland. He was a member of the Academy of Technical Sciences, and president of the Physical Society of Warsaw. His agile, penetrating and critical mind, swift reasoning, and almost uncanny facility for operating with figures mentally, made every discussion in the Physical Society a lively and exciting event. His was a most remarkable and versatile mind; apart from being a brilliant experimenter and highly skilled in various techniques, he was an excellent theoretician and had a deep knowledge of mathematics. He spoke fluently many languages, was a classical scholar and had great literary talent. His quickness and wit, combined with a deep sense of humour, made him most popular at all scientific and social gatherings. An excellent speaker, he had a particular gift of presenting difficult problems in a simple manner, and his public lectures—masterpieces in language and composition—always attracted large audiences. His articles in various magazines and Sunday papers contributed a great deal to the popularization of science in Poland. He translated a number of books into Polish, the last being Madame Curie's "Radioactivité"; the translation of this was just finished when war broke out, and it achieved the unique honour of being published by the underground movement; it was the main scientific book used by the students of Poland's Underground University, in which Prof. Wertenstein took an active part. Little is yet known about his fate during the war years; but he was hunted by the Germans and had to hide in various parts of the country. Finally he managed to escape to Hungary, and there, on the eve of the liberation of Budapest by the Red Army, he was killed by a shell fragment during the battle for that city.

I cannot end this note without a tribute to Prof. Wertenstein's character and personality. He possessed such virtues as made him an outstanding man even without his scientific achievements. He was exceptionally kind, generous, friendly and utterly unselfish. Everyone who knew him was charmed and attracted by his cordiality, cheerfulness and modesty. But we, his students, who worked with him closely, could most fully appreciate the integrity of his character. He was not merely a teacher but also a friend and counsellor; he cared not only for our intellectual needs but also for our general welfare, and would not spare any efforts to meet any of our difficulties. He will always remain in our memory a symbol of the ideal man of science, a perfect blend of brilliance and kindness, erudition and good humour, enthusiasm for Nature and love of humanity. J. Rotblat.

Prof. Walter Makower, O.B.E.

The death of Prof. W. Makower at the age of sixty-five occurred on July 7. Makower graduated from University College, London, where he took honours in chemistry; but going to Cambridge as a research student under Thomson effected his transformation into a physicist, and his M.A. was for a thesis on the diffusion properties of radium emanation (radon). From the Cavendish Laboratory he went to Manchester as a John Harling Research Fellow under the directorship of Schuster. On the latter's retirement in 1906, Makower became lecturer on the staff of Rutherford, whose arrival in Manchester gave a great impetus to radioactive studies. Over a period of years Makower did experimental work in this subject; he showed that radium *A*, *B* and *C* all had different temperatures of volatilization and that the behaviour of the active deposit depended largely on the pressure conditions within the vessel. Later on he collaborated with Prof. S. Russ on radioactive recoil, with Fajans on the beta-rays from radium *B* and with Moseley on the gamma radiation from the same substance; with Geiger he wrote a timely book on radioactive measurements. He had previously written one of the earliest books on radioactivity entitled "The Radioactive Substances".

Outside the precincts of the Physics Department, Makower spent a good deal of his leisure at the kite-flying station installed high up on the moors above Glossop in Derbyshire. He escaped injury when the kite he was flying was struck, setting on fire the hut in which the winding machinery was installed.

The War of 1914–18 found him serving first as a lieutenant R.N.V.R. and then as a captain R.F.C.; both positions he filled in a scientific capacity.

After sixteen years service in the Physics Department at Manchester, Makower became attached to the research laboratory of the Dunlop Rubber Company, but he was glad to return to professional life when appointed in 1925 to the post of professor of science at the Royal Military Academy, Woolwich. This post he held until 1938 when he resigned; he was awarded the O.B.E. in 1934.

During the years of retirement he did valuable work for the Institute of Physics.

Walter Makower came of a cultured family, all the members being musical; he was no mean performer on the 'cello. Those who knew him intimately valued him most for his sense of humour and his integrity of mind. He married Dorothy Lois Drey who, with their two daughters and a son, survives him.

Miss E. R. Saunders

The obituaries of Miss E. R. Saunders in *Nature* of August 18, 1945, while describing her morphological and educational work, do not refer to her contributions to genetics. These were, however, of the first importance. In 1897 she began experimental plant breeding at Cambridge in collaboration with Bateson, and the results were presented to the Evolution Committee of the Royal Society in 1901. Meanwhile Mendel's work had been rediscovered in 1900. By 1901 she had established the existence of Mendelian inheritance in *Lychnis*, *Datura* and *Matthiola*. It is clear that she and Bateson had independently rediscovered some at least of Mendel's laws before his work was known to them. She must in fact be regarded as the 'mother' of British plant genetics.

Her later genetical research was mainly on *Matthiola incana*. Here she successfully analysed what was then the most complicated known case of genic interaction. Any of four independent recessive genes may render a plant of this normally hoary species glabrous. Two of them also make it white. She also described, in connexion with doubleness, what, in modern terminology, is the first case of balanced lethals, and the second case of linkage. Up to her death she continued to display a lively interest in all branches of genetics, and was treasurer of the Genetical Society. To all geneticists her death was a loss; to many a personal loss. J. B. S. Haldane.

Dr. G. V. Buchanan

Dr. Gwynneth Vaughan Buchanan, senior lecturer in zoology at the University of Melbourne, died towards the end of June 1945. Dr. Buchanan was born in Sydney in November 1886, and was educated at Toorak College and the University of Melbourne. For a time she acted as professor of zoology in the University of Western Australia before she returned to her old university as senior lecturer under Sir Baldwin Spencer. To English zoologists she is perhaps best known for her outstanding work on the development of the marsupials, undertaken in conjunction with Dr. Elizabeth Frazer at University College, London, in 1918. In Australia, the great influence for good that she exercised on the many students to whom she was so much more than a mere university teacher will long be remembered. It was largely owing to her influence and enthusiasm that the McCoy Society for Field Investigation and Research came into being and became such an outstanding success. After some months of ill-health, bravely borne, she retired from active teaching in February of this year, but until the last she continued her enormous correspondence with old students scattered, by the War, to distant parts of the world.

F. Wood Jones.

NEWS and VIEWS

Chemistry at Leeds: Retirement of Prof. W. R. Whytlaw-Gray, O.B.E., F.R.S.

PROF. ROBERT W. WHYTLAW-GRAY is retiring from the chair of chemistry in the University of Leeds at the end of this month after twenty-two years service. During his administration, the Department of Chemistry has undergone many changes, including its entry into a new building, in the design and equipment of which he took a leading part, and which has proved to be almost ideally arranged for both teaching and research. Throughout his academic life at University College, London, in Bonn, at Eton or in Leeds, Prof. Whytlaw-Gray has devoted himself wholeheartedly to research work, whether in pursuit of exact knowledge for its own sake or (for the second time) in the application of his special experience to his country's war-time problems. Before going to Leeds, he had developed a technique for the examination of smokes with the ultra-microscope which led to the determination of particle size and number, and to the discovery that these aerial systems, unlike the more familiar hydrosols, are unstable and undergoing continuous coagulation. At Leeds, with the help of collaborators, notably Dr. Colvin, Mr. H. S. Patterson and Dr. W. Cawood, the coagulation process was fully explored, new methods developed both for counting the particles when suspended and after sedimentation, and, in a series of papers, the kinetics of smoke coagulation established on a sound quantitative basis. The results of these investigations and their bearing on aerial systems in general were summarized in the Liversidge Lecture delivered before the Chemical Society in 1935 and in a book entitled "Smokes" written in collaboration with H. S. Patterson.

Prof. Whytlaw-Gray has always been much interested in the determination of the atomic and molecular weights of gases by physico-chemical methods, and many investigations in this field have been made in the Leeds laboratories. Previous experience in determining the density of radon by means of a Steele and Grant microbalance led him to the development of a buoyancy microbalance capable of high accuracy in which constancy of zero was ensured by a torsion fibre suspension. With this instrument the limiting densities of xenon, carbon monoxide, carbon dioxide, ethylene, carbon tetrafluoride, methyl fluoride, silane, nitrous oxide and hydrogen sulphide were determined, and values for the atomic weights of carbon, fluorine, nitrogen, sulphur and silicon obtained which are independent of stoichiometric relationships. This work with gases containing carbon first brought to light an error in the atomic weight of carbon which, prior to 1933, was accepted by the International Committee as 12·00. The mean value found at Leeds was 12·011, which has been amply confirmed since by modern stoichiometric determinations and also by mass-spectrographic evidence. In these and other ways, Whytlaw-Gray has built up an influential research school at Leeds, and well and truly carried on the tradition of his distinguished teacher, Ramsay. He has never rested on his achievements, although these have received universal recognition. Ripening experience has, in his case, resulted rather in more devotion to experimental work and to its stimulation in others. It is a source of great satisfaction to his colleagues that he is to continue his investigations in the Department of Inorganic and Physical Chemistry at Leeds.

Prof. M. G. Evans and Prof. E. G. Cox

WITH the retirement of Prof. Whytlaw-Gray, the Council has decided to unite the hitherto separate Departments of Inorganic and Physical Chemistry. The combined Department will have two professors, of whom Prof. M. G. Evans, professor of physical chemistry in the University since 1939 (see *Nature*, July 1, 1939, p. 15), will be the senior. Dr. E. G. Cox, reader in chemical crystallography in the University of Birmingham, has been appointed to the second chair in the Department. For several years Dr. Cox has been on leave of absence to undertake highly specialized and secret work in the Government service, and has had charge of a laboratory. Latterly he held the rank of lieutenant-colonel on the staff of the B.L.A. in Europe. Dr. Cox is well known as one of the ablest experimenters in X-ray crystallography. His researches in the carbohydrate field, and also in connexion with co-ordination compounds, have won for him a high place as an investigator in structural chemistry. Graduating with first-class honours in the University of Bristol some twenty years ago, he proceeded to the Davy Faraday Laboratory at the Royal Institution and became a pupil of Sir William Bragg. From there he was appointed to a lectureship in physical chemistry in the University of Birmingham, and has been associated with Prof. W. N. Haworth in constitutional work on sugars and polysaccharides. One of his most notable researches was on the structure of vitamin C.

Penicillin Production in Great Britain

ON September 20, Glaxo Laboratories, Ltd., Greenford, Middlesex, gave a demonstration of the preparation of penicillin and showed the factory operation of freeze-drying and other processes through which the finished product goes; Sir Cecil Weir, director-general of equipment and stores, Ministry of Supply, was present. Sir Cecil said that during the War when key installations were open to enemy attack, it would have been wrong to give information about the location of factories concerned; but now it is possible to disclose that the production of penicillin is under way, or about to commence, in twelve factories in Britain, operated by eight firms well known in the pharmaceutical field or in fermentation processes. Britain will soon have in operation the largest penicillin production unit in the world at Speke, and one of the largest at Barnard Castle; the latter is to be run by Glaxo Laboratories, and will make four for which the firm is responsible.

As soon as it became evident in 1942 that factory production of penicillin was feasible, the Ministry of Supply brought together potential manufacturers and scientific men, and the present results are due to the team-work thus initiated. As British resources in building and operational labour, as well as scientific and technical staff, were fully extended, it was not expected that progress would be so rapid in Britain as in the United States, but close touch was maintained on the subject between the two countries. Britain has shared with the United States for military purposes the greater production which that country was able to obtain during the War; but it will not be long before Britain is producing penicillin on a comparable basis. The history of penicillin production during the War has much in common with that of the atomic bomb; in both cases production was undertaken in the United States on account of the greater facilities available and the freedom from bombing. Sir Cecil also referred to recent references in the Press to the possibility that penicillin may become infected in the course of manufacture. This danger always exists in fermentation processes, particularly in the early development of a new factory, but, as was to be seen at the Glaxo Laboratories, the manufacturers take every precaution to maintain sterility; and there is no ground for any suggestion that a great deal of penicillin is unfit for use.

Folk-Lore of Toothache

In a recent article on this subject (*Brit. Dent. J.*, **78**, 226 and 257; 1945), forming the quinquennial Wallis Lecture and read before a conjoint meeting of the Sections of Odontology and History of Medicine of the Royal Society of Medicine, Dr. J. D. Rolleston said that the abundance of dental folk-lore was shown by the numerous books and articles, of which the best known in alphabetical order were those of Baldinger, Bremner, Guerini, Haber, Kahn, Kanner, Lindsay, Lufkin, Sudhoff, Taylor, Townend and Weinberger. Owing to the extensive character of dental folk-lore, Dr. Rolleston confined himself to its most prominent aspect, toothache, and no reference was made to the superstitions of normal dentition, the discoloration and mutilation of the teeth in savage races, the legend of the Golden Tooth, the toothpick and the toothbrush and the various aspects of dental surgery, apart from a brief allusion to filling and extraction.

There are numerous examples of the transfer of toothache to other persons, as can be seen from Sir James Frazer's volume of the "Golden Bough" entitled "The Scapegoat". Hydrotherapy for toothache was instanced by the large number of wells believed to cure toothache, especially in Scotland, the Palatinate and Upper Austria. Charms against toothache date back for many centuries, the earliest of the kind having been found in the Babylonian legends of 4000 B.C. During the Middle Ages, charms, which are the most popular of toothache remedies, were sometimes spoken, but were more frequently inscribed on paper, parchment, wood or stone, and were hung round the patient's neck or loins. Professional charmers have existed until modern times. Patron saints play an important part in the folk-lore of toothache, as they do in that of other diseases. The chief patron saint of dentistry is St. Apollinaria, who died a martyr in A.D. 249, whose memory is kept alive by relics and pilgrimages in various European cities and in Britain. Besides St. Apollinaria there are more than twenty saints supposed to relieve or cure toothache.

The Night Sky in October

New moon occurs on Oct. 6d. 05h. 22m., U.T., and full moon on Oct. 21d. 05h. 32m. The following conjunctions with the moon take place: Oct. 3d. 12h., Venus 4° S.; Oct. 27d. 05h., Mars 0·8° S.; Oct. 27d. 05h., Saturn 2° S. In addition to these conjunctions with the moon, the following conjunctions take place: Mars in conjunction with Saturn on Oct. 26d. 07h., Mars 1·4° N.; Venus in conjunction with Jupiter on Oct. 30d. 08h., Venus 0·5° N. No occultations of stars brighter than magnitude 6 take place during the month. Mercury is in superior conjunction with the sun on Oct. 2 and is unfavourably placed for observation during the month. Venus is a morning star, rising at 3h. 12m., 3h. 56m., and 4h. 45m., at the beginning, middle and end of the month respectively. Mars, in the constellation of Gemini, rises at 22h. 08m. on Oct. 1 and at 21h. 15m. on Oct. 31. Jupiter, in conjunction with the sun on Oct. 1, rises an hour before the sun at the middle of the month and a little more than two hours before the sun at the end of the month, and can be seen in the morning hours. Saturn, in the constellation of Gemini, rises at 23h. 07m. on Oct. 1 and at 21h. 15m. on Oct. 31. The Orionid meteors are due about the third week in October, but moonlight will partly interfere with observations of this shower.

Announcements

Messrs. Coventry Gauge and Tool Co., Ltd., Taylor, Taylor and Hobson, Ltd., and E. R. Watts and Son, Ltd., have agreed to co-operate in the development and distribution of precision engineering and optical equipment. They will pool their technical and manufacturing resources for the development of new instruments, while the sales and service departments will handle the products of all three firms.

It is announced that a catalogue of all the medical films in Great Britain is now being prepared by the Royal Society of Medicine in co-operation with the Scientific Film Association. It would be appreciated if any persons having films of medical or para-medical interest, who have not already been asked for details, would communicate with the Film Cataloguer, Royal Society of Medicine, 1 Wimpole Street, W.1. By so doing they would not commit themselves or their films, but would enable the catalogue to be complete.

The National Cancer Institute at Bethesda, Maryland, has undertaken to compile and publish all the data available relative to cancer therapy. All types of therapy except surgery and irradiation will be covered. Negative and positive results of the treatment of spontaneous, transplanted and induced experimental tumours, and of clinical cases, will be included. The data will be classified and tabulated in a simple manner similar to that in Hartwell's "Survey of Compounds Which Have Been Tested for Carcinogenic Activity" (National Cancer Institute, 1941). Reprints of published work in this field or any unpublished results which may be used should be sent to Prof. Helen M. Dyer, National Cancer Institute, Bethesda 14, Maryland, U.S.A.

The Electrical Association for Women is marking its twenty-first anniversary by an exhibition, arranged by the British Electrical Development Association, at the Dorland Hall, Lower Regent Street, London, S.W.1, during October 11–25. The exhibition will be opened by the Duchess of Kent, and at the following luncheon Sir Stafford Cripps will speak. On October 12 there will be addresses by Sir Robert Watson-Watt, Dr. Kathleen Lonsdale and Sir Harry Railing. The Women's Engineering Society, the body from which the Electrical Association for Women arose, is holding its annual conference during October 12–13; Miss M. M. Partridge will give the presidential address on "The Next Twenty-one Years".

Erratum. In *Nature* of September 22, p. 371, col. 1, line 23, for "the production of gas from sulphur" read "the production of gas almost free from sulphur".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

A New Test for 2 × 2 Tables

UNDER this heading, G. A. Barnard[1] puts forward a test which, in language adopted from Neyman and Pearson, "is more powerful than Fisher's". This means in practice that the test advocated passes as significant certain classes of experimental result which, by the test I had put forward[2], would have been judged insignificant; and that, as judged by Barnard's method, my test is thought to be too stringent. However one may choose to express it, the cause of the difference in these calculations is worth elucidating, and, in taking the view he does, Barnard is following the very distinguished precedent of Prof. E. B. Wilson, whose similar proposal a few years ago[3] led to some clarification of the issue[4,5,6].

In the treatment of the problem for which I am responsible, all possible fourfold tables are classified according to the marginal distributions they exhibit. Thus in the case considered by Barnard in which, using three experimental and three control animals, the experimental animals all die and the control animals all survive, the two marginal distributions are both specified by the partition (3^2). Subject to this restriction, only four different experimental results are possible, symbolized by

$$\begin{array}{c|c}3&0\\\hline 0&3\end{array}\qquad\begin{array}{c|c}2&1\\\hline 1&2\end{array}\qquad\begin{array}{c|c}1&2\\\hline 2&1\end{array}\qquad\begin{array}{c|c}0&3\\\hline 3&0\end{array};$$

and I have demonstrated that, *whatever may be the probability of survival*, if it is the same for both lots, the probabilities of these four possible outcomes are in the ratio 1 : 9 : 9 : 1; or, in other words, the probability of obtaining the most successful outcome by chance is always 1 in 20. For any other marginal distributions a similar series can be obtained, but with these even the most favourable outcome has so high a chance probability that in no case could it be judged significant. It is my view that the existence of these less informative possibilities should not affect our judgment of significance based on the series actually observed.

It may, however, be demonstrated that with repeated sampling, using always three experimental and three control animals having the same probability of death, such outcomes will often occur. If it were legitimate to judge the level of significance from the proportion of significant judgments in the whole series of 'repeated sampling from the same population', these cases would be brought in to inflate the denominator of the fraction. The least possible frequency of these other series occurs when the chance of death is $\frac{1}{2}$ for both groups, and, in the aggregate, they will then occur 44 times to 20 occurrences of the series observed. Thus Barnard's argument leads to the conclusion that the acceptance of the result as significant is at the significance level 1/64 rather than 1/20; or, more properly, that it has some unknown value not greater than 1 in 64.

In my view the notion of defining the level of significance by 'repeated sampling of the same population' is misleading in the theory of small samples just because it allows of the uncritical inclusion in the denominator of material irrelevant to a critical judgment of what has been observed. In 2 of the 64 cases enumerated above, all animals die or all survive. The fact that such an unhelpful outcome as these might occur, or must occur with a certain probability, is surely no reason for enhancing our judgment of significance in cases where it has not occurred; any more than the possibility that a breeding experiment might have yielded too few offspring to allow one to draw any significant conclusion should not enhance our judgment of significance whenever there are enough offspring for the significance of any supposed effect to be worth discussing.

Of course, the notion of repeated sampling from the same population is usually taken to imply that the total size of the sample is fixed. The total size does not, however, always suffice to specify the type of sample which has been obtained, and it is only the sampling distribution of samples of the same type that can supply a rational test of significance.

R. A. FISHER.

Department of Genetics,
University of Cambridge.
Aug. 13.

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[1] Barnard, G. A., *Nature*, 156, 177 (1945).

[2] Fisher, R. A., "Statistical Methods for Research Workers" (Edinburgh: Oliver and Boyd, 1944), Section 21.02.

[3] Wilson, E. B., *Science*, 93, 557 (1941).

[4] Fisher, R. A., *Science*, 94, 210 (1941).

[5] Wilson, E. B., *Proc. U.S. Nat. Acad. Sci.*, 28, 94 (1942).

[6] Wilson, E. B., and Worcester, Jane, *Proc. U.S. Nat. Acad. Sci.*, 28, 378 (1942).

A Classical Theory of Electromagnetism and Gravitation

ATTEMPTS to obtain a unified theory of gravitational and electromagnetic phenomena[1] have assumed the form of generalizing the equations of general relativity theory, so that they incorporate terms which may be identified with electromagnetic potentials and charge and current distributions. At the moment it seems that these attempts will not lead to an explanation of such quantum theoretical results as the indeterminacy principle, and their very complexity makes it difficult to see how they will yield a hint as to necessary modifications of the equations of quantum theory required to overcome the difficulties inherent in its present form. In any event, such a synthesis of gravitational and electromagnetic phenomena in quantum theory is generally regarded as secondary in importance, since gravitational forces on elementary particles are extremely small.

It seems of interest, however, to return to the classical theory and look for a simple set of equations which give simultaneously a relativistically covariant theory of gravitational and electromagnetic phenomena. For regions of space occupied only by charge and current distributions, the Maxwell-Lorentz equations

$$\frac{\partial f_{\nu\sigma}}{\partial x_\mu} + \frac{\partial f_{\sigma\mu}}{\partial x_\nu} + \frac{\partial f_{\mu\nu}}{\partial x_\sigma} = 0,$$

$$\frac{\partial f_{\mu\nu}}{\partial x_\nu} = \frac{4\pi}{c}\, i_\mu, \quad k_\mu = \frac{1}{c}\, f_{\mu\nu} i_\nu \quad . \quad . \quad (1)$$

give a very satisfactory system of Lorentz covariant equations for the determination of either the electromagnetic field produced by a given charge distribution or the behaviour of a charged body in such a field. The equations are simplified if the Lorentz condition

$$\frac{\partial A_\nu}{\partial x_\nu} = 0 \quad . \quad . \quad . \quad . \quad . \quad (2)$$

be applied, where

$$f_{\mu\nu} = \frac{\partial A_\nu}{\partial x_\mu} - \frac{\partial A_\mu}{\partial x_\nu}.$$

In these equations gravitational forces do not appear, and it is usual in classical theory to treat problems involving gravitational potentials separately. The original theory of Kaluza is based on the introduction of an extra dimension, of no physical significance. We therefore consider the above equations (1) and (2) when we allow the suffixes to assume the values 1 up to 5. Writing $A_5 = -\Omega$, $i_5 = c\sigma_0$, $x_5 = R$, we are led to the equations

$$\nabla \cdot \mathbf{A} + \frac{\dot{\phi}}{c} - \frac{\partial \Omega}{\partial R} = 0 \quad . \quad . \quad . \quad . \quad (3)$$

$$\left(\nabla^2 - \frac{1}{c^2}\frac{\partial^2}{\partial t^2} + \frac{\partial^2}{\partial R^2}\right) \begin{matrix} \mathbf{A} \\ \varphi \\ \Omega \end{matrix} = -4\pi \left| \begin{matrix} i/c \\ -\rho \\ \sigma_0 \end{matrix} \right. \quad . \quad . \quad (4)$$

$$\left.\begin{aligned} \mathbf{k} &= \mathbf{E}\rho + \frac{1}{c}(\mathbf{i} \times \mathbf{H}) - \sigma_0 \nabla \Omega - \sigma_0 \frac{\partial \mathbf{A}}{\partial R} \\ cW &= \mathbf{i} \cdot \mathbf{E} + \sigma_0 \dot{\Omega} - c\sigma_0 \frac{\partial \varphi}{\partial R} \end{aligned}\right\} \quad . \quad (5)$$

$$\nabla \cdot \mathbf{i} + \dot{\rho} = -c \frac{\partial \sigma_0}{\partial R} \quad . \quad . \quad . \quad . \quad (6)$$

Equations (5) suggest that σ_0 may be identified with the rest density, and Ω with the gravitational potential. Since σ_0 is invariant for rotations of the axes $x_1 \ldots x_4$, the result arises that gravitational force per unit volume is exerted only on the rest-mass density, and not on the increased density arising from a possible velocity of the matter relative to the observer. If we set $\frac{\partial}{\partial R} \equiv 0$, the equations are applicable to flat space-time, and gravitational waves are seen from (4) to be propagated with the velocity of light. In agreement with the generalized unified theories, equation (6) shows that charge is conserved only for flat space-time.

It does not seem reasonable that the extra dimension R should be singled out for special attention, and in general the gauge is shown from (3) to be simply connected with the rate of change of the gravitational potential in this extra direction. We may attach physical significance to R if it is noted that the radius of curvature of space-time at a particular point is different for observers accelerated with respect to each other. We therefore postulate that to an observer S_0 falling freely under the influence of the local gravitational field, space-time in his immediate neighbourhood appears flat, and we may set $\frac{\partial}{\partial R} \equiv 0$. To an observer S accelerated with respect to S_0, the same space appears to have a finite principal radius of curvature R. From these assumptions a simple generalized theory of transformations may be developed to compare the observations of observers accelerated with respect to each other, in the same way that the theory of Lorentz transformations yields the results of the special theory of relativity.

Details of the theory will be published later.

H. C. Corben.

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University of Melbourne.
May 24.

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[1] Weyl, *Ann. Phys.*, **59**, 101 (1919). Kaluza, *Sitz. Preuss. Akad. Wiss.*, 966 (1921). Pauli, *Ann. Phys.*, **18**, 305, 337 (1933). Einstein and Mayer, *Berl. Ber.*, 541 (1931); 130 (1932).

Cosmic Rays and Kinematical Relativity

I admit (indeed, I insist on) Prof. Haldane's claim[1] that kinematical relativity would be justified in substituting another "equally valid" cause of the red-shift for relative motion; my point is that it has not done so. In my letter[2], I named all the causes (I do not insist on this terminology if Prof. Haldane can think of a simpler and equally clear one) I could think of, and Prof. Milne chose[3] relative motion. It was then that I repeated the objection Prof. Haldane has quoted. If he prefers a different choice from Prof. Milne's, I will repeat the objection to that. It is, however, futile to run from one untenable explanation to another, like a squirrel in a cage.

The basic objection to Prof. Milne's theory is that it allows the distance between Prof. Haldane's nose and the lamp-post to remain constant at what it was, say, one minute before impact, in spite of the fact that his nose is broken. It will concentrate the whole problem into a single point if Prof. Haldane will state how he accounts for his disfigurement, and how he dates subsequent events, on the time-scale which keeps the lamp-post a constant distance away.

I am not sanguine of the possibility of convincing Prof. Milne by a *reductio ad absurdum*. Deductions concerning stellar evolution are apt to become 'verifiable' in a few billion years time. In the meantime, I believe I have reduced the fundamental principle, not merely a particular application, to absurdity by the argument now under discussion; but Milne refuses to regard this as a blemish because I have not indicated a flaw in his voluminous mathematics[3]. He will not recognize that an absurdity can follow from false premises even though (indeed, because) the connecting mathematical argument is faultless. Hence I do not expect that any difficulty connected with what is presumed to have happened a thousand million years ago will convince him that he is following a will-o'-the-wisp.

As regards cosmic rays, Milne's theory of this phenomenon[4] requires space to be filled with particles moving faster than light; but he gets around this by saying that such particles would be unobservable. I pointed out some time ago[5] that such particles, if they existed, must be constantly hitting stars, and since their momentum would be infinite the consequences would not be unobservable. No reply has been made to this. So much for the hopes of a test of the theory arising from "agreement or disagreement with fact of calculations concerning cosmic rays".

Herbert Dingle.

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London, S.W.7.

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[1] *Nature*, **156**, 266 (1945).

[2] *Nature*, **155**, 511 (1945).

[3] *Nature*, **155**, 512 (1945).

[4] "Relativity, Gravitation and World Structure", p. 234.

[5] "Through Science to Philosophy" (1937), p. 198.

Interaction of Aluminium Halides with the Xylenes

Recently[1], it has been suggested that the study of equilibria between the aromatic hydrocarbons[2] in the presence of aluminium halides might be complicated by the formation of stable complexes between the aluminium halide and some of the hydrocarbons. If, as has been shown[1], the heat of complex formation varies considerably with different hydrocarbons, then the composition of the equilibrium mixture of free hydrocarbons will be different from the composition of the mixture of hydrocarbons in the complex. This may lead to uncertainty in the equilibrium concentrations of hydrocarbons, if, as in much of the experimental work described in the literature[2,3], only the total hydrocarbon, including both the free hydrocarbon and that obtained by decomposing the complex, is analysed, since this may result in equilibria which appear to vary with the ratio of aluminium halide to hydrocarbon. Some recent exploratory experiments of ours are of interest in this connexion.

At equilibrium, the system aluminium halide and xylene separates into two phases: (*A*) a supernatant, pale brown, mobile layer which contains only a trace of aluminium halide; (*B*) a more dense, very dark brown, viscous layer which contains most of the aluminium halide. This latter layer can be separated, as has been suggested by Norris and Rubenstein[4], into two fractions: (*B*1) a colourless hydrocarbon layer containing no aluminium halide, which is separated from the non-volatile fraction *B*2 by vacuum distillation at 20° C.; and (*B*2) a very dark, very viscous residue which, when carefully decomposed with water at 0° C., gives an almost colourless hydrocarbon mixture.

In the present work, these three fractions (*A*, *B*1, *B*2) were distilled in vacuum at 20° C., washed with dilute caustic soda and then water, and dried with calcium chloride. The compositions of the fractions were determined from their ultra-violet spectra, since aromatic hydrocarbons have characteristic spectra in this region. The absorption spectra of 0·5 per cent solutions by volume of these fractions in spectroscopically pure *cyclo*hexane were photographed using an absorption path-length of 1·8 mm. The starting materials were either a *meta-para* xylene mixture (approximately 4 : 1) or an *ortho-meta* mixture (approximately 95 per cent *ortho*), and these were equilibrated at 20° C. and at 60° C. with aluminium chloride.

Inspection of all the photographs suggested: (1) Fraction *B*2 is always different from *A* and different from *B*1. (2) *B*1 is, in all cases, very nearly the same as, or possibly identical with, *A*. (3) *B*2, formed when starting with the *ortho-meta* mixture, is not the same as when the *meta-para* mixture is used. In the latter case, *B*2 is almost entirely pure *meta*-xylene. There is no evidence that *B*2 is in true thermodynamic equilibrium. (4) Starting with the *meta-para* mixture, true equilibrium appears to be reached in the fraction *A*, since no variation of the composition with time has been found. This is in general agreement with Pitzer and Scott[2]. (5) Starting with the *ortho-meta* mixture, fraction *A* does not appear to reach equilibrium although longer times were employed than in (4). This may be due to: (i) the reaction having further to go to reach equilibrium when the starting material is largely *ortho*; (ii) the complex formed from *ortho* is different from that from *meta* and may not be so active catalytically; (iii) side reactions may become important when starting with *ortho*; our analyses cannot exclude the presence of toluene after reaction, although benzene is certainly absent. (6) In the reaction starting with the *ortho-meta* mixture, aluminium bromide behaves qualitatively similarly to the chloride.

These results show that the system is very complicated, and, although much more work must be done before the system is completely understood, the following picture appears to be qualitatively correct. At equilibrium, the system aluminium chloride and xylene forms two immiscible liquid phases, one of which is a very dilute solution of the aluminium chloride complex in the normal equilibrium hydrocarbon mixture, and the other is a mixture of the complex and the normal equilibrium hydrocarbon mixture. The composition of the hydrocarbon mixtures in the complex and in the free state is always different. Before a picture of aromatic equilibria can be completed, a detailed analysis of all possible separate phases is essential.

One of us (E. F. G. H.) wishes to thank the Director of Fuel Research for permission to publish this communication.

H. CAMPBELL.
E. F. G. HERINGTON.
Department of Colloid Science,
University, Cambridge.
June 12.

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[1] Campbell and Eley, *Nature*, 154, 85 (1944)

[2] For example, Pitzer and Scott, *J. Amer. Chem. Soc.*, 65, 803 (1943).

[3] Norris and Vaala, *J Amer Chem. Soc.*, 61, 2131 (1939).

[4] Norris and Rubenstein, *J. Amer. Chem. Soc.*, 61, 1163 (1939).

A Sexual Reproduction Cycle of *Trypanosoma congolense* Broden

DURING the course of work on the destruction of trypanosomes by phagocytes in the blood of cattle, gamete forms of *Tryp. congolense* were observed in thick unfixed blood smears, both paired and unpaired.

This phenomenon, at first thought to be an appearance caused by staining with Giemsa of unfixed blood preparations, was studied, and developmental forms were found in Giemsa-stained smears and sections from the skin of infected cattle. *Tryp. congolense* was then stimulated to conjugate by addition to a drop of heavily infected mouse blood of a drop of hypotonic saline solution (0·3 per cent sodium chloride), and the actual conjugation was seen under the microscope. This technique, though possibly unsuitable for a morphological study of trypanosome forms, is convenient, since the process of conjugation can be studied with ease, owing to hæmolysis of most red blood cells. It is not, however, constantly seen, and it may be supposed that mature gametocytes are not always present.

In mouse blood, treated in this way, trypanosomes are not fatally injured, though the adult form is distended. Sexually mature forms quickly become micro- and macro-gametes and conjugate within ten minutes. The micro-gamete is 6–9 μ in length and the nucleus becomes posteriorly placed, with the rest of the body an attenuated filament; macrogametes are 13–19 μ in length, with the nucleus somewhat anteriorly placed, both nucleus and cytoplasm being intensely granular, except for a swollen area posteriorly which is clear and translucent. The posterior end of the microgamete enters the translucent posterior area of the macrogamete, and the microgamete is absorbed.

A motile zygote is formed, of trypanosome form, but tapering from the posterior end. Nuclear material is next concentrated centrally or posteriorly, and by contraction of other parts of the body an amorphous oocyst is formed. The oocyst nucleus may after sixty minutes have divided once. The zygote is about 20 μ in length, and oocyst about half this size.

Oocysts have been found in skin sections and in the lung of one calf, which was successively exposed to cold at 4° C., in order to occlude the skin capillaries and drive the trypanosomes into the general circulation. Oocysts have also been studied in skin smears on supravital slides (neutral red) kept moist by addition of a drop of normal bovine serum. The oocyst appears to form sporoblasts, probably eight, which divide into innumerable sporozoites. The sporozoites break away from the oocyst body and swim actively away by a kind of rolling movement.

The fate of the sporozoite is uncertain. It is initially about 1–2 μ in diameter and its morphology has not been fully determined. It is probably leishmannioid, since larger forms have been seen of this type. It does not aggregate or develop in the tissues, though skin smears reveal developmental forms—leptomonad, crithidial and immature trypanosome. It is suspected that the macrophages are parasitized, since in skin, lymphatic gland and kidney sections, these cells have been found containing bodies, the larger of which are leishmannioid in appearance.

Trypanosomes treated with hypotonic saline in mouse blood react in three different ways and are plainly of three different forms as follows:

(1) Immature sexual or asexual. These become swollen by the saline, but show no other changes, though some may conjugate after forty-five minutes. (2) Mature sexual forms, which conjugate as described. (3) Infective (?) forms, which become changed into a variety of developmental types, usually associated with life in the tsetse fly, such as round forms, stumpy forms, elongated forms and so on.

These matters will shortly be described at greater length in a preliminary communication, and a full report published when all details have been studied.

R. N. T.-W.-Fiennes.

Veterinary Research Laboratory,
P.O. Box 24, Entebbe,
Uganda. June 23.

Multiplication *in vitro* of Koch Bodies of *Theileria annulata*

The following simple method modified from Jacoby (1944) was found suitable for the growth *in vitro* of *Theileria annulata*. A small fragment of infected calf's spleen or lymphatic gland is placed on a sterile glass coverslip and a drop each of calf plasma and chickens' embryonic extract are added. After coagulation the coverslip is sealed to the bottom of a large Carrel flask by a drop of plasma and embryonic extract; 3–5 c.c. of a mixture of 30–40 per cent calf serum in Tyrode is then added and the flask closed and incubated. On this medium Koch bodies survive for at least twelve days, but do not multiply. If fragments of normal spleen are placed in juxtaposition to the infected fragment at intervals of 3–5 days, Koch bodies survive for 15–18 days, but there is no obvious multiplication. The addition of glutamine (3 γ per c.c.), pyridoxin (0·6 γ per c.c.), inositol (4 γ per c.c.) and riboflavine (0·04 γ per c.c.) to the mixture of serum and Tyrode induces multiplication of Koch bodies, which was observed in ten successive fragments of normal calf spleen during a period of two months. The addition of these factors to the transplant, in which Koch bodies have survived without multiplication for eighteen days, immediately induced multiplication of the surviving parasites.

It is interesting to note that, *in vitro*, good growths are obtained in spleen fragments of recovered animals and overlying fluid containing 40 per cent of serum of the same animals. *In vivo* massive inoculation of infected blood or macerated infected lymph glands do not produce an attack of theileriosis in recovered calves, which always harbour a residual infection.

I have to thank Prof. Adler for his advice and Dr. Grossowitz for his kind help.

I. Tchernomoretz.

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July 3.

Histological Fixation of Locomotory Patterns

Normal histological methods usually fail to yield a satisfactory picture of the shape and form of a muscle at any given phase of its activity. For such purposes the following technique has been found useful in the case of small terrestrial or aquatic animals. Absolute alcohol is cooled to about −117° C. by submersion in liquid air. Small terrestrial animals moving over fine wire gauze or thin aluminium foil are quickly dipped into the alcohol, and aquatic animals moving in a small quantity of water contained in a spoon of aluminium foil are treated likewise.

Fixation for histological investigation can be achieved in a number of different ways, according to the material used; for example, dehydration in a frozen condition, gradual thawing in alcohol plus formic acid, etc.

Animals investigated so far include Planarians, Nemertines, Annelids, Gastropods, Myriapods, and small vertebrates. Fixation appears to be instantaneous; the tentacles of snails and slugs remain protracted, and the locomotory waves are clearly recognizable. The setæ protrude in the longitudinally contracted segments of an earthworm, and are retracted in the elongated segments.

The details of the method will be discussed elsewhere. It is hoped that it may help to correlate, more satisfactorily than has been possible hitherto, structure and function within the animal body.

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A Modification of Slide-Culture Technique

A very simple and effective method of making slide-cultures for the study of moulds is described below. It has many advantages over the methods described by Henrici[1] (p. 30), Lewis and Hopper[2] (p. 221), Langeron[3] (p. 957), and Smith[4] (p. 176). The procedure, a slight modification of existing methods of slide-culture, was worked out by M. C. White and me jointly, while attached to the laboratories of the South African Institute for Medical Research, Johannesburg, on military duties.

Sterile nutrient agar is melted in a culture tube, in a water bath, and allowed to cool down to between 40°–45° C. This is inoculated fairly heavily with spores of the mould to be studied taken from a pure culture. A very small drop of the inoculated agar is transferred to a flamed slide by means of a platinum loop and is immediately covered over with a flamed coverslip. It should be noted that a hollow-ground slide is not employed. The agar drop must be of such a size that when the coverslip is gently pressed flat the agar occupies a circle about half the diameter of that of the coverslip.

The slide-culture is incubated in a petri dish, in the bottom of which are a few layers of wet filter paper, the whole having previously been autoclaved. Suitable glass supports raise the slide well above the level of the wet paper. During incubation it is important that the paper should not dry out, and sterile water should be added periodically if necessary. Smith[4] (p. 176) recommends the use of a 20 per cent solution of glycerol instead of water, as the latter tends to wet agar.

On incubation the mycelium spreads rapidly through the agar, and hyphæ and sporophores then grow out into the airspace under the coverslip. When a suitable growth has occurred, usually after three or four days, the preparation may be made into a semi-permanent mount by introducing Shear's mounting fluid, with or without added stain, under the coverslip. Air bubbles which are formed are easily removed by placing the preparation in a jar, which is then evacuated by means of a vacuum pump. More durable preparations can then be made by ringing the coverslip with any of the usual ringing cements.

P. H. B. TALBOT.

Division of Botany and Plant Pathology,
Pretoria.
May 30.

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[1] Henrici, A. T., "Moulds, Yeasts and Actinomycetes" (New York, 1930)

[2] Lewis, G. M., and Hopper, M. E, "An Introduction to Medical Mycology" (Chicago, 1939).

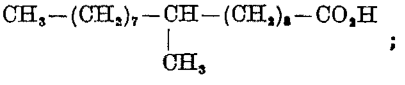
[3] Langeron, M., "Précis de Microscopie" (Paris, 1925).

[4] Smith, G, "An Introduction to Industrial Mycology" (2nd Edit., London, 1942)

Fatty Constituents of Tubercle Bacilli as Growth-inhibitors of the same Bacilli

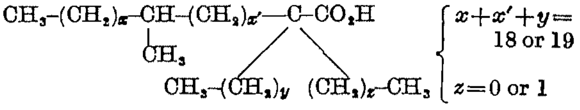
A MOST valuable clue in the search for bactericidal compounds has recently been found in the so-called 'antagonism principle' between bacterial vitamins and similarly built molecules of 'antivitamins'[1]. In the field of tuberculosis, this principle is unfortunately of little interest, as the bacilli responsible for this disease seem to need no vitamins for their growth. But an antagonism may be conceived to arise between plastic constituents of tubercle bacilli and substances with very closely related molecular structure, so that such substances can replace the former in the cellular frame without being able to exert any of the necessary vital functions.

Attempting to approach the problem of chemotherapy of tuberculosis from this point of view, I have studied the substitution of a naturally occurring chemical function by an 'unbiological' one, in the very molecules of some constituents of tubercle bacilli. Anderson, Chargaff, Robinson and others[2] have shown that these bacteria contain a fairly high proportion of numerous fatty acids that have not been encountered yet in any other living cell. Only two of these acids have been characterized with sufficient chemical accuracy (the tuberculostearic (I) and the phtioic acids (II)); but it has become clear now that many others are also highly branched-chain molecules. Employing Anderson's method, a mixture of such fatty acids was isolated from the dead bacilli of a virulent stock of human origin, and distilled in cathodic vacuum to remove the fractions of too high molecular weight, as well as any traces of waxy alcoholic acids. It was converted then, through the acid chlorides and the amides, into a mixture of primary amines, using a slightly modified Jeffreys' method. Whereas the initial material and the amides are practically inactive, the mixture of amines so obtained (in form of the hydrochlorides) proved itself to be strongly bacteriostatic against tubercle bacilli growing on synthetic media (at such high dilutions as 1/10,000 and more). Hence it is clear that a naturally occurring substance endowed with vital properties may be changed into a specifically toxic material through the single replacement of a carboxyl by an amino-group. It is noteworthy that synthetic fatty amines such as (III), prepared from higher fatty amides following Montagne's process[3], also exhibit more or less bacteriostatic properties against acid-fast bacteria.

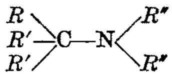


$$CH_3-(CH_2)_7-\underset{\substack{|\\ CH_3}}{CH}-(CH_2)_8-CO_2H \quad ;$$

(I)



(II)



(III)

Work is in progress in this field, and also to ascertain whether the amidine-group may be of use for the same purpose. But it is perhaps worth while stressing the fact that such an *in vitro* conversion of the constituents of a bacterium into an inhibitor, through the modification of a radical while maintaining the molecular configuration, forms a bridge between chemotherapeutic methods and immunological ones.

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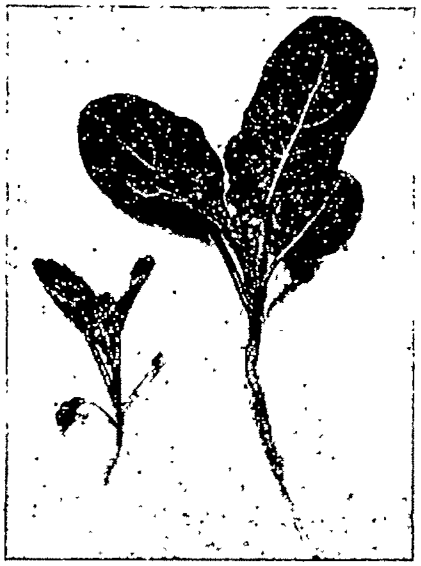
A Case of Molybdenum Deficiency in New Zealand

IN a small private-garden investigation into the disease 'whiptail' of cauliflowers, extreme symptoms appeared in those plants not treated with the group of trace elements manganese, zinc, copper and molybdenum. The matter was therefore studied more closely in the glasshouse. In an experiment involving some twenty combinations of two and three of the elements manganese, zinc, copper, molybdenum and



COMPARISON OF MOLYBDENUM-DEFICIENT AND HEALTHY CAULIFLOWER SEEDLINGS. *Photo: S. A. Emmerson.*

boron with and without lime, and in which phosphate, potash and nitrogen were adequately provided, 'whiptail' failed to develop. At an early stage of growth, however, all plants not supplied with molybdenum developed an intervenal chlorosis very similar to that described by Arnon and Stout[2] in molybdenum-deficient tomatoes. The symptoms were much more pronounced where lime had been omitted. This is in line with a body of evidence[5,7,8,11,12] that soil molybdenum is more available for plant uptake in limed or naturally alkaline soil. The unlimed plants in particular also showed the involution of the leaf edges and marginal necrosis seen in the tomatoes. The addition of sodium molybdate to the soil brought about a rapid recovery of the affected plants. No marked growth differences were associated with the symptoms, and eventually all plants grew out of the condition. The habit of the plants was not normal in the glasshouse and they were not left to reach maturity.

The characteristic leaf distortions of 'whiptail' could very well be caused by a check in growth of the leaf margins. A further small experiment was therefore carried out *in situ* to see if under natural conditions molybdenum might not prove the critical factor. Treatments with and without added molybdenum were compared, phosphate, potash and nitrate being supplied in each case, but no lime. The rate of application of molybdenum (3 lb. of sodium molybdate per acre) may have been a little high, as some germination injury occurred. The contrast between the two treatments was most striking; the plants without molybdenum being chlorotic and making very little progress, while those with the addition were vigorous and dark green in colour. The characteristic mottling was not evident until some growth had been made, the young plants showing a more general chlorosis.

At the present stage, 'whiptail' appears to be developing in some plants of both treatments, and the deficiency described may have no connexion with the disease. 'Whiptail' is usually stated as occurring on very acid soils and as being controlled by heavy liming[3,9,13]. One instance has been described, at Mickleton, Gloucestershire, on a soil containing free lime.

The soil worked with is an unusually acid phase of Ngaio silt loam (pH 4·7, percentage saturation 35), and the strain of cauliflower Southern Cross.

Molybdenum deficiency has been shown to occur in South Australia[1] and Tasmania[4,5,6,12]; but this is the first instance demonstrated in New Zealand.

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Calomel and Onion Eelworm

MOSLEY has recently suggested[1] that, by liberally dressing onion seed with calomel, control may be obtained not only of onion fly and onion white rot but, possibly, also of the onion eelworm, *Anguillulina dipsaci* (Kühn).

In order to test this, the following experiment was set up. Large numbers of quiescent, infective larvæ of *A. dipsaci* were available in the form of eelworm 'wool' obtained from narcissus bulbs in October 1944. The nematodes in this state revive on being moistened and swim freely in water, and it is in this stage that I have shown that they may occur attached to the outside of commercial samples of onion seed[2]. Preliminary tests showed that the eelworms readily revived from the 'wool' when placed in water; the material was thus quite suitable for the intended tests.

Small portions of it a few millimetres in diameter, and each consisting of some hundreds of the parasite, were coated with finely powdered calomel and then placed in fresh garden soil contained in glass tubes 2 in. long by 1 in. wide. Each tube was half-filled with good rich kitchen garden soil. A piece of 'wool', well covered with calomel, was then inserted, and the tube was filled with more soil with the object of ensuring that, if the calomel decomposed in the soil, any of its decomposition products would be in intimate contact with the reviving eelworms. A drop of sterile water was added to each tube sufficient to moisten the soil. A tube without calomel was put up in exactly the same way to serve as a control. All the tubes were then set aside in a moist chamber on the laboratory bench and left for any action to take place. After the lapse of five, eleven and nineteen days, water extracts of the soil from the tubes were made by the Baermann funnel technique. This is a very simple and efficient method for obtaining eelworms from plant material and soil. A piece of rubber tubing is placed on the stem of a glass funnel and is closed by a pinchcock. The funnel is then partly filled with tap water to a convenient depth and clamped in an upright position. The material to be extracted, wrapped in a piece of cheese-cloth, is then gently submerged in the water and left for an hour or two. Living eelworms soon begin to wriggle out of the material and, sinking down through the water, collect in the stem of the funnel. By opening the pinchcock and running out some of the water into a Petri dish, eelworms can be searched for under the microscope.

In the extracts made in this way from portions of soil from the control tube and from calomel-treated tubes after five, eleven and nineteen days, large numbers of living *A. dipsaci* were obtained swimming freely in the water. The worms from the calomel tubes were just as lively as those from the control tube, thus indicating that the calomel, or its decomposition products, had had no lethal action on the worms reviving from the 'wool'. It seems improbable, therefore, that calomel is likely to prove of service for the control of the eelworm attached to onion seed. If its decomposition products do not destroy the parasite by the nineteenth day after contact (by which time the bulk of the seed in any good sample of onion seed would have germinated) its use as an effective control for seed-borne infections of the eelworm seems to be ruled out. I have determined that the parasite on onion seed can be completely controlled by the fumigation of onion seed with methyl bromide, which does not injure the seed but retards its germination slightly[3].

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Control of Dry Rot of Seed Potatoes by Dusting

AT the present time, the only practicable method of controlling dry rot of seed potatoes (*Fusarium cœruleum*) is to dip the tubers immediately on lifting in a solution of one of the proprietary organo-mercury compounds prepared for the purpose[1,2]. This requires large numbers of boxes in which the tubers must be placed to dry—extra labour at an already busy season—since the toxic nature of the dip necessitates the removal of ware potatoes before treatment, and, in many cases, considerable outlay in plant. For these reasons, dipping seems suited mainly to the large specialist growers and not to the smaller farmers whose crops form the bulk of the tonnage concerned.

The wide adoption of any method of control of dry rot depends on (1) effectiveness, (2) absence of deleterious effect on the tubers, (3) ease of application, and (4) small capital outlay on plant. Only a dry treatment appears likely to fulfil all these conditions. In 1938, Dr. R. G. Tomkins, of the Low Temperature Research Station, Cambridge, suggested to one of us (C. E. F.) five volatile compounds which he considered worth testing. These were α-naphthol, thymol, diphenyl, 4 chlorophenylphenol and 2 : 5 dichloronitrobenzene. Peat was suggested as a suitable carrier. Preliminary experiments showed thymol to be the most promising of these, and large-scale trials with this compound have been carried out during the past three years on Scotch seed, under conditions approaching those found in commercial practice. Kaolin was used provisionally as a carrier after trials comparing it with peat and gypsum. The rate of application has been 12 oz. thymol, made up to 10 lb. with kaolin, per ton of potatoes. A single application, either on lifting or on riddling for dispatch to England in December or March, has been found to give somewhat variable results; but a double application, that is, both on lifting and on riddling, has been found to provide excellent control of the disease, on the average slightly better than that obtained with the standard single treatment with organo-mercury dip mentioned above.

CONTROL OF DRY ROT BY DUSTING WITH THYMOL KAOLIN. TUBERS TREATED 'AS GROWN' AND CLAMPED ON LIFTING · SEED RE-TREATED ON RIDDLING FOR DISPATCH TO ENGLAND.

Variety	Date dispatched	Dry rot per cent (April)	
		Untreated	Thymol kaolin
Catriona	December	17	1
Arran Pilot	December	46	1
Arran Pilot	March	19	5
Doon Star	December	31	4
Doon Star	March	32	3

These results, subject to confirmation by further trials planned for this season, indicate that the double treatment with thymol kaolin fulfils the first postulate of effectiveness. Unfortunately, however, it does not fulfil the second, as marked phytocidal effects on the tubers were noted in some of the experiments. The exact conditions governing the severity of the damage are not known; but burning has been found to be most severe on wounded surfaces and where tubers were kept in a humid environment after treatment. Immature tubers are thus more subject to damage because of their liability to skin abrasions. Varietal differences also occur; for example, Doon Star has been found to be much less susceptible to thymol injury than Arran Pilot and may be almost undamaged.

The third and fourth postulates, those of ease of handling and small capital outlay, are certainly covered, since dusting on lifting may be done by hand by a boy working with each collecting cart, while treatment on riddling could be accomplished automatically by means of a simple distributor placed over the bag chute. In addition—although further information on this point has still to be obtained—thymol might be considered sufficiently harmless to permit of treating both ware and seed, thus allowing the normal practice of clamping the crop 'as grown' when harvested.

Although the thymol dust cannot be advocated for commercial use unless its burning action can be overcome, the satisfactory level of control obtained shows that there are practical possibilities in the dry method of treatment.

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RESEARCH ITEMS

New Genera and Species of Fishes

HENRY B. FOWLER describes two new genera and two new species in recent papers (*Notulæ Naturæ*, Academy of Natural Sciences of Philadelphia, "Description of a New Genus and Species of Apogonid Fish from New Jersey", No. 130, April 1944; "Description of a New Genus and a New Species of American Stromateid Fishes", No. 142, June 1944). The first, *Mimocubiceps virginiæ*, is of special interest, for, besides representing a new genus and species with interesting affinities, it introduces to the New Jersey fish fauna a family (Apogonidæ) not hitherto found within the limits of the State. This genus approaches *Erythrobussothen* Parr, but differs in many details. The second genus, *Simobrama*, is proposed for a harvest fish *Seserinus xanthurus* Quoy and Gaimard from Brazil, which is here redescribed, together with a related form, *Peprilus burti*, new species from the Gulf of Mexico.

Marine Cottid Fishes of California

IN a detailed review of the family Cottidæ, Rolf L. Bolin makes a most useful addition to the literature of the subject (*Stanford Ichthyological Bull.*, 3, No. 1; Oct. 1944). Almost one tenth of the marine fishes of California are members of this family, most of which live in tide pools or are shallow-water species. Identification hitherto has been very difficult and the present work will be a real help to ecologists, parasitologists and other biologists who are not specialists in ichthyology. There is an artificial key to the nineteen genera, each species is carefully described and the majority of them figured, keys being given for the species in many cases. The drawings of these fishes are exceptionally good.

Callianassidæ of the Central Pacific

UNDER this title Charles Howard Edmondson surveys the Callianassidæ taken mainly from the shallow reefs at Oahu, Hawaii (*Occasional Papers Bernice P. Bishop Museum*, Honolulu, Hawaii, 18, No. 2; 1944). Several species are described, the most interesting being a new species of *Callianassa* belonging to the subgenus *Calliactites* (*Callianassa* (*Calliactites*) *parva*), for the author has hatched out its larva. Hitherto no larva belonging to this sub-genus was known, and it is to be hoped that a detailed description of this peculiar form will be forthcoming in the near future. The larva differs from any known *Callianassa* larvæ in having no dorsal spine on the second abdominal somite and in having a thin spine-like rostrum instead of one that is broad, flat and toothed. The sixth abdominal somite is already formed and the telson is rounded posteriorly with only ten spines instead of the usual fourteen or more. The eyes are exposed and it may be that we have here a case of abbreviated development. Unfortunately the appendages are neither described nor figured. In his latest paper on this group, Gurney (*Proc. Zool. Soc.*, 114; 1944) gives six species the larvæ of which have been positively identified, four of which belong to the sub-genus *Trypaea*, one to *Cheramus* and one to *Callichirus*. Those belonging to the first two are of the same type and differ from the third, but none of these resembles the form here described. As the larvæ are probably an important guide to the relationships of the Callianassidæ a further description of this new species is much needed.

Examining the Functional Condition of the Liver

IN *Maroc-Médical* (Dec. 1944), J. Bailly and G. Decrop have an article with the title "A Propos D'Un Procede D'Exploration Simple De L'Etat Fonctionnel Du Foie", in which they describe minor modifications introduced into Pallardo's method for determining the state of the liver. Briefly, this method consisted in the administration of about 2·5 mgm. of a salt of quinine dissolved in a glass of water, and half an hour and an hour later samples of the urine are examined for the presence of quinine, tests being made by means of Tanret's reaction. In cases of absolutely healthy livers the quinine is completely disintegrated and hence does not appear in the urine. If, however, there should be any delay in the elimination of the quinine which has not been disintegrated, as often occurs, misleading results may be obtained, and Pallardo recommends the prolongation of the period of observation. Certain modifications in the method have been made by Bailey and Decrop because some unsatisfactory features accompany the tests advocated by Pallardo, among which may be mentioned Tanret's reaction. Their procedure is as follows. To 10 c.c. of the urine are added 10 drops of ammonia and then 10–15 c.c. of ether. After stirring the mixture and allowing it to stand for a time, the ether separates and floats on the underlying liquid which is drawn off, and the ether is transferred to a test tube. On adding 2 c.c. of $N/10$ sulphuric acid and stirring, the acid liquid is precipitated to the bottom of the tube and assumes a beautiful blue fluorescence if quinine is present. Results obtained from sixteen cases are given.

Germination of Bearded Iris Seeds

THE complexity of the factors affecting seed germination is illustrated in a study by L. F. Randolph and L. G. Cox (*Proc. Amer. Soc. Hort. Sci.*, 43, 284; 1943) on the germination of the seed of the bearded Iris (*Iris germica*). Cold storage of air-dry seed at − 2° to + 4° C. gave increased germination as compared with storage at normal temperatures, but high-temperature (35° C.) storage reduced germination, while alternating high and low temperatures were no more effective than low temperature alone. Wet storage of seeds increased the rate but not the final amount of germination. The importance of the seed-coat effect was shown by the fact that excised embryos in nutrient solution and embryos in contact with half the endosperm germinated more rapidly and to a greater extent than did intact seeds. Chipping of the seeds was not effective unless the cap of endosperm covering the radicle was removed, and the effect was further increased if the chipped seeds were leached in running water. Chipped, but not intact, seeds had their germination increased by additional oxygen.

Root Distribution of Fruit Trees

The failure of fruit trees to respond to fertilizer application may be due to a variety of factors. Sometimes either because of the soil character or the root distribution the added fertilizer fails to reach the absorbing roots. E. L. Proebsting (*Proc. Amer. Soc. Hort. Sci.*, 43, 1; 1943) summarizes studies on the root distribution of fruit trees in a well drained Californian orchard and shows that for cherries, almonds, apricots, peaches and prunes the maximum root concentration is between 2 ft. and 5 ft. deep. There are few roots at a greater depth and few in the surface foot (and these mostly at between 8 in. and

12 in.). In this case, root development nearer the surface is probably inhibited by high summer temperatures and when peach seedlings were grown in containers artificially heated by immersion in water, maximum root growth occurred when the soil temperature was maintained at 75° F. Higher temperatures were deleterious and at 95° F. less root growth occurred than with any other temperature within the range of 45–95° F.

Lowering of Sea-Level in Glacial Times

THE question of Quaternary sea-levels is an important one, especially in connexion with geomorphology and the migrations of plants, animals and man. Unfortunately, estimates of the lowering of the ocean surface due to the locking-up of water in the Pleistocene ice-sheets differ very widely. Antevs (1928) arrived at limits of 290–305 ft. for the fall in level due to the last glaciation, while Ramsay (posthumous publication in 1930) suggested limits of 183–275 metres for the lowering due to the maximum glaciation. The difference is out of all proportion to the difference between the volumes of ice involved in these two phases of glaciation. A. Farrington, in the *Proc. Roy. Irish Acad.*, **50**, 237 (1945), approaches the problem from a new direction. It is assumed that after the withdrawal of the last European ice-sheet the movements of land and sea were upwards in the main. In these circumstances the only evidence of the return of water to the sea is to be found in natural records of increasing depth. Brögger's study of the late-glacial deposits of the Oslo Fjord indicates that when the ice stood at the outer Ra, the older Yoldia clay was being deposited in water 10–30 m. deep. The younger Yoldia clay contains a fauna pointing to a depth of 40–60 m., while the later Arca clay has characters appropriate to deposition at 80–100 m. This evidence suggests that 70 m. is a conservative estimate for the rise of sea-level during the interval considered. It is further known that during the later period of the Ancyclus Lake the bed of the North Sea was dry land down to 50 m. below the present sea-level. A gap, including the Yoldia Sea period, intervenes between the two rises of more than 70 and 50 m., so that the total rise is at least 120 m., or 400 ft., since the beginning of the ice stand at the outer Ra. Remembering that the bulk of the European ice-sheet had already greatly wasted by the time it had retreated to the outer Ra, it follows, either that the North American ice-sheets melted later, which cannot be lightly assumed, or that the 400 ft. of recorded rise is only a part of the total rise. It is concluded that Antev's estimates of the change of sea-level and of the volume of the ice-masses are much too small.

Earthquakes in New Zealand during 1942–43

DURING 1942, 262 earthquakes and earth tremors had their epicentres in New Zealand (*Dominion Obs. Bull.* No. S-69. By R. C. Hayes, Wellington, N.Z. 1944). An epicentral map concerning these shows that by far the majority of the shocks occurred north of lat. 42·5° S., and very few occurred north of Auckland. According to Hayes, the most notable feature of the map is the concentration of activity in the Wairarapa district, due to the large number of subsidiary shocks following the outbreak of activity on June 24, 1942. Two other notable features during the year were: (1) the shock of June 27 with epicentre near White Island and focal depth 230 miles; this is the deepest origin so far recorded in the New Zealand region; (2) the shock of October 31 in the south-east Tasman Sea, where seismic activity very rarely occurs. During 1943, 213 earthquakes and earth tremors had their epicentres in New Zealand (*Dominion Obs. Bull.* No. S-71. By R. C. Hayes, Wellington, N.Z. 1944). The epicentral map in this case shows the same area as in 1942 covered with epicentres, except that during this year the shock area extended a little farther south, to lat. 43° S. Additionally there was an unusual amount of activity in the south-western portion of South Island, where two shocks reached minor destructive intensity (M.M.7). It was again noted by Hayes that there was a marked concentration of activity in the Wairarapa region, most of the shocks being of slight intensity.

Moving-Coil Instruments

THE design of moving-coil instruments includes a consideration of such factors as damping and speed of response, in addition to torque, resistance, etc. A paper by G. F. Tagg (*J. Inst. Elect. Eng.*, **92**, Pt. 2, No. 27, June 1945) presents the information necessary to understand the performance of a moving-coil instrument under various conditions in as complete a form as possible, and in such a form that it can readily be used. In the ordinary forms of instruments such as ammeters and voltmeters, the time/deflexion characteristics are of importance in determining the damping and the time of response, but have no effect on the steady reading of the instrument. In special types of instrument, such as the ballistic galvanometer and the flux meter, the time/deflexion characteristics are of importance in determining the reading given by the instrument.

'Cosmic Static'

THIS is the name given by Grote Reber (*Astrophys. J.*, **100**, 279; 1944) to naturally occurring short radio waves which reach the earth continuously at an intensity which is found to depend markedly on the direction of arrival. The radiation is apparently closely confined to the plane of the Milky Way. Measurements are made in the range 156–164 Mc./sec. (1·87 metres) with an $f/0{\cdot}6$ sheet-metal mirror 30 ft. in diameter mounted so as to swing in the meridian on a horizontal east-west axis. Electromagnetic radiation collected during the earth's rotation from a declination band determined by the elevation of the mirror is focused by it on to an antenna system which converts the waves into alternating current. This is then amplified and rectified and the resulting D.C. voltage drives a pen, which records on a moving tape the intensity of 'cosmic static' against right ascension for a given declination. A glance at specimen records shows that a marked maximum appears on the trace each time the mirror traverses the plane of the galaxy. The radiation becomes unmeasurably small at galactic latitudes above about 30°. There is also a strong dependence on galactic longitude: a main region of disturbance coincides with the direction of the galactic centre in Sagittarius, there are secondary maxima in Cygnus, Cassiopeia, Canis Major and Puppis, and a minimum occurs in Perseus. Though the absolute intensity is small (10^{-21} watts per megacycle band falling on a square centimetre from a square degree in Sagittarius), the effect is undoubted. Reber points out that the intensity from any direction seems to be roughly proportional to the amount of cosmic material in that direction, but ventures no suggestion as to the mode of production of this extraordinary radiation.

GROWTH INHIBITION IN PEA SEEDLINGS

By E. DOROTHY BRAIN

THE inhibition of the growth of lateral buds by the application of auxins in high concentrations to the apical surface of cut stems is well known, and it is often associated with marked swelling of the cut stems. Borgström[1] explains both the inhibition and the swelling as being due to increased supplies of auxin set free in a transverse flow from the phloem, induced by the decapitation of the main stem. He considers that the swelling is a secondary effect of the increased auxin supply and not otherwise related to the inhibition of the buds. In the experiments which are described below observations have been made on seedlings of *Pisum sativum* after treatment with *H* 11 extract of urine, three fractions of *H* 11 and some pure substances. The effect of the various applications on the growth of the cut epicotyls both in height and width and on the development and growth of lateral buds was examined. The plants were grown in pots of soil in the light until three or four internodes high, and then placed in the dark for twenty-four hours before experimenting and for forty-eight hours after treatment, being kept throughout the experiment under glass covers in a moist atmosphere. The inhibiting effect was calculated as the percentage difference between the averages for the total length of the side shoots in treated and control plants.

H 11 extract is an alcoholic extract of urine prepared by the Hosa Research Laboratories and used for treatment of tumour growth. The concentration of paste used for these experiments was equivalent to 3·5 c.c. *H* 11 extract in 6 gm. of pure lanoline. Tests were made with various dilutions of this. Treatment with concentrated paste when epicotyls were decapitated just below the terminal bud caused increased growth of the cut stems and marked swelling at the top of the stems. In plants decapitated at the node below which growth has ceased, treatment caused no increase in the height of cut stems nor did any swelling occur, but lateral buds were inhibited rather more than in the plants which had only the apical part removed.

Three fractions of *H* 11 extract were prepared by the Hosa Laboratories: (1) 80 *K* was prepared from the filtrate after the precipitation of neutral *H* 11 with copper sulphate; (2) 80 *L* was prepared from the soluble fraction after extracting the precipitate with dilute hydrochloric acid; (3) 80 *M* was prepared by dissolving the tarry substance which remained in 4 *N* sodium hydroxide. Lanoline paste was made with each fraction using 5 c.c. in 3·5 c.c. paraffin mixed with 2 gm. of lanoline. When applied to cut epicotyls 80 *K* and 80 *M* resulted in inhibition to side shoots, but 80 *L* had no inhibitory effect. 80 *L* and 80 *M* both caused greater swelling of the cut stem than 80 *K*. It appears as if 80 *K* contained an inhibitory substance which did not cause stems to swell as the other fractions did. Thompson *et al.*[2] found that 80 *M* was stimulatory to tumour growth.

As it was known that *H* 11 extract contained β-indole acetic acid and its sodium salt[3] a comparison was made between the effects of different concentrations of pure β-indole acetic acid and *H* 11, and it was found that a paste containing approximately 6,250 units β-indole acetic acid caused equivalent inhibition to the concentrated *H* 11 paste but less swelling of the stems. Series of experiments, in which paste made with a solution of β-indole acetic acid neutralized with sodium hydroxide was used, showed more swelling in the stems treated with the sodium salt than with the acid. The presence of the sodium salt in *H* 11 extract would therefore account for the marked swelling noted in the cut stems. Avery[4] has recorded that the potassium salt of β-indole acetic acid is twice as active as the acid in the *Avena* test.

Analysis of *H* 11 extract[5] having indicated the presence of a member of the quinone series, it was considered useful to test the effect of similar substances on cut stems. The following solutions were therefore used: (1) a saturated solution of anthraquinone in distilled water; (2) anthraquinone 2.6 di-sulphonic acid refined sodium salt, 0·1 per cent in distilled water; (3) 1.5 di-hydroxy anthraquinone, 0·1 per cent in distilled water. Results of these experiments showed a slight increase in the height of cut stems and inhibition of the growth of side shoots after treatment with anthraquinone and anthraquinone 2.6 di-sulphonic acid refined sodium salt. 1.5 dihydroxy anthraquinone caused less increase in the height of the cut stems and increased growth of side shoots. No swelling of the stems occurred.

Pisum sativum epicotyls

Applications to cut stems	Percentage inhibition of lateral shoots	Percentage increase in width of cut stems
H 11 extract	70·2	150·0
Fractions of *H* 11		
80 *K*	42·86	50·0
80 *L*	—	100·0
80 *M*	41·67	100·0
β-indole acetic acid, 6,250 units per gram lanoline	69·6	76·8
Anthraquinone saturated solution	73·4	—
Anthraquinone 2.6 di-sulphonic acid refined sodium salt 0·1 per cent	54·4	—
1.5 di-hydroxy anthraquinone 0·1 per cent	—	—

A comparison of the amount of inhibition and swelling caused by these different applications is given in the accompanying table. It is evident from these results that substances which cause inhibition may not cause swelling in the stem and that auxin application may inhibit without causing swelling if the actively growing internodes of the stem are removed.

Snow[6] states that the inhibitive influence travelling up the lateral shoot is a hormone other than auxin and finds evidence in his experiments that another substance is active in inhibiting lateral buds in pea seedlings. No previous record has been found of inhibition by substances other than auxin when applied apically to the cut stem, and it is hoped to carry out more experiments to test the inhibition of other substances along these lines.

I am indebted to Mr. J. H. Thompson, director of research of Hosa Research Laboratories, for providing the *H* 11 extracts and other substances.

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[1] Borgström, Georg, "The Transverse Reactions of Plants", 126-131 (Lund: C. W. K. Gleerup; Copenhagen: Ejnar Munksgaard; London: Williams and Norgate, Ltd., 1939).

[2] Thompson, J. H., Holt, P. F., and Jones, R. Forbes, *Nature*, 151, 23 (1943).

[3] Thompson, J. H., *Brit. Med. J.* (July 31, 1943).

[4] Avery, George S., Jr., Buckholder, P. R., and Creighton, Harriet B., *Amer. J. Bot.*, 24, 226 (1937).

[5] Thompson, J. H., "Cancer Research", *Medical World* (Oct. 13, 1944).

[6] Snow, R., *New Phyt.*, 39 (2), 177 (1940).

CELL PROLIFERATION, CARBOHYDRATE BREAKDOWN, AND HYDRATION OF ENZYME PROTEIN

By Dr. A. LASNITZKI
Department of Physiology, University of Birmingham

THE interesting result that the rate of anærobic glycolysis of embryonic and post-embryonic tissue, from a warm-blooded animal, decreases gradually in successive stages of development[1,2] has demonstrated a close relationship between enzymatic breakdown of carbohydrates, particularly that of glucose, and the proliferation of tissue cells, having regard to the fact that, in general, the rate of this proliferation likewise diminishes as development progresses[3]. The significance of this parallelism has further been emphasized by the result that, in normal tissues, the rate of anærobic glycolysis corresponds approximately to the rate of carbohydrate oxidation under ærobic conditions[4].

The most appropriate interpretation of the relation appears to be that the energy required for cell proliferation originates, directly or indirectly, in carbohydrate breakdown; in particular, this view indicates that the relation must hold for any type of growing tissue, including tumour tissue, the latter possessing a considerable ability to metabolize glucose, although this is, even under ærobic conditions, largely confined to anoxidative glucose splitting[1,2,4]. A distinction must be made, however, between the *supply* of energy by a process of this kind and the final *utilization* of that energy for the purpose of growth, and the possibility of a disconformity between these two factors must be considered in estimating the result that, in the case of tumours, rate of cell proliferation and intensity of glycolysis have not shown throughout the same clear relation obtained with tissues growing normally[5]. On the other hand, in certain tissues of the adult organism (for example, nervous tissue), in which cell proliferation has come to an end, although a relatively high carbohydrate metabolism persists[1,4], it is an obvious assumption that the liberated energy will be utilized for the maintenance of specialized functions.

Another fact of relevant interest is provided by the observation, frequently noted, that the water content of the entire animal body as well as of individual tissues gradually decreases in the course of embryonic and post-embryonic development, so that rapidly growing tissues, that is, tissues with intense cell proliferation, as a rule contain more water than corresponding tissues growing at a slower rate[6]. A very similar relation was found for tumour tissue[7]. In all probability, the increase in tissue water is due in great part to a rise in water content of the cellular constituents, and this rise is likely to be associated with an increased hydration of cell proteins. The most important kinds of proteins, in this connexion, appear to be those which constitute the protein components of enzymes, and, in particular, of such enzymes as are involved to a varying extent in the breakdown of carbohydrates.

These considerations suggest, therefore, that the intensity of carbohydrate breakdown in a growing tissue, and consequently the rate of cell proliferation, depends largely on the degree of hydration of corresponding enzyme proteins, so that, within limits, an increase in hydration stimulates and a decrease inhibits that enzymatic activity[8]. The suggestion attempts to elucidate the biological significance of the increased water content of rapidly growing tissues by relating it, through the concept of protein hydration, to the metabolic process which serves as the source of energy for cell proliferation; and the order of causation thus supposed can be represented as follows:

1		2		3
Degree of hydration of enzyme proteins involved in carbohydrate breakdown	→	Intensity of carbohydrate breakdown	→	Rate of cell proliferation.

Some experimental evidence regarding the validity of relation 1 → 2 may be obtained from the results of studies on the action of ions upon glycolysis and related processes. Thus it was found[9] that the splitting of 'lactacidogen' (probably a hexosephosphate) by frog muscle could be modified under the influence of various anions in a manner which, on the whole, corresponded to their position in the Hofmeister series, anions with hydrating effects upon proteins (and hydrophilic colloids in general) causing an acceleration, and those with dehydrating effects an inhibition, or even reversion, of the process. As to warm-blooded animals, a number of investigations[10] have shown the pronounced inhibitory effect of fluoride upon the glycolytic activity of normal tissues and tumours, an effect which agrees with the strongly dehydrating power of that anion; while other studies[11,12], likewise performed with both normal and tumour tissue, have shown that glycolysis, as well as carbohydrate oxidation, could be markedly stimulated by potassium, a cation which favours hydration.

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[1] Warburg, O., "The Metabolism of Tumours", translated by F. Dickens (London, 1930) (collected publications by Warburg and co-workers); also Warburg, O., and Kubowitz, F., *Biochem. Z.*, **189**, 242 (1927).

[2] Rosenthal, O., and Lasnitzki, A., *Biochem. Z.*, **196**, 340 (1928).

[3] As to this point, see specially: Minot, C. S., "The Problem of Age, Growth, and Death" (London, 1908).

[4] Dickens, F., and Šimer, F., *Biochem. J.*, **24**, 1301 (1930); **25**, 985 (1931).

[5] Boyland, E., and Boyland, M. E., *Biochem. J.*, **33**, 618 (1939).

[6] For references: Aron, H., in "Handbuch der Biochemie", edited by C. Oppenheimer, 7, 152 (Jena, 1927). Needham, J., "Chemical Embryology", **2**, 870, 883 (Cambridge, 1931).

[7] Cramer, W., *J. Physiol.*, **50**, 322 (1916).

[8] Cf. Lasnitzki, A., *Z. Krebsforsch.*, **27**, 115 (1928).

[9] Embden, G., and Lehnartz., E., *Hoppe-Seyl. Z.*, **134**, 243 (1924).

[10] For example: Dickens, F., and Šimer, F., *Biochem. J.*, **23**, 936 (1929). Sellei, C., and Jány, J., *Biochem. Z.*, **239**, 94 (1931).

[11] Lasnitzki, A., see ref. 8, *Biochem. Z.*, **264**, 285 (1933); *Protoplasma*, **22**, 274 (1934). Lasnitzki, A., and Rosenthal, O., *Biochem. Z.*, **262**, 203 (1933).

[12] Ashford, C. A., and Dixon, K. C., *Biochem. J.*, **29**, 157 (1935). Dickens, F., and Greville, G. D., *Biochem. J.*, **29**, 1468 (1935).

TWO NEW ANTIBIOTICS

IN a note in *Nature* of November 18, 1944, p. 631, attention was directed to the need for an antiseptic or antibiotic which would effectively control infections with Gram-negative micro-organisms, many of which are not susceptible to penicillin. Among these are the typhoid-dysentery group of organisms, *Brucella*, *Hæmophilus* and those common invaders of wounds, *Proteus vulgaris* and *Pseudomonas pyocyaneus*. The tubercle bacillus is also resistant to penicillin. A reference has now appeared (*Brit. Med. J.*, 706, May 19, 1945) to two new antibiotics derived from soil Actinomycetes which do act upon various Gram-negative organisms and also seem to inhibit the development of tuberculosis in guinea pigs. They have been isolated by S. A. Waksman and his colleagues (*Proc. Mayo Clin.*, 19, 537; 1944; and *Proc. Soc. Expt. Biol., N.Y.*, 55, 66; 1944) and are called 'streptomycin' and 'streptothricin'. Streptomycin seems to be the more valuable of the two. It is obtained from *Actinomyces griseus* and, like streptothricin, is very stable and resists moderate heat, storage and the action of most other organisms, in marked contrast to penicillin. It appears to be an organic base, soluble in water, but not in ether and chloroform. It inhibits *in vitro* the growth of human strains of the tubercle bacillus, the Gram-positive *B. subtilis* and *Staphylococcus aureus*, and the Gram-negative *Bact. coli, Brucella abortus, Bact. aerogenes* and various organisms of the *Salmonella* and dysentery groups. It has, unlike penicillin, a moderate inhibitory action upon the growth of *Proteus, Salmonella aertrycke* and *Pseudomonas pyocyanea.* Its toxicity to animals is fairly low. The antibacterial action of streptothricin is similar, but less powerful; and it acts upon fewer organisms.

No clinical trials have yet been reported with these substances, but tests done on mice show that streptomycin very effectively protects mice against mixed infections with *Proteus vulgaris* and an anaerobic streptococcus, both obtained from a human infection. Good results have followed the treatment with streptomycin and streptothricin of mice and chick embryos infected with various *Salmonella* species and with *Brucella abortus*. Heilman (*Proc. Mayo Clin.*, 19, 553; 1944) has reported that *Pasteurella tularensis*, the cause of tularæmia, which is not affected by sulphonamides or penicillin, is three times as sensitive as *Bact. coli* to streptomycin, which prevents infection of mice with *P. tularensis*. Feldman and Hinshaw (*Proc. Mayo Clin.*, 19, 593; 1944) have shown that, in guinea pigs inoculated with virulent tubercle bacilli and treated for sixty days with streptomycin, tuberculosis was scarcely detectable microscopically, although viable bacilli were still present, while the control animals not so treated showed widespread tuberculosis. The antibacterial action of streptomycin is, these authors think, comparable to that of promin, which they also studied.

It is clear that streptomycin and streptothricin urgently require further clinical study. An important obstacle to their clinical trial on a sufficiently extensive scale may well be the difficulty of producing them in sufficient quantity, and it is to be hoped that it will be possible to overcome this. There is considerable evidence that, although the remarkable properties of penicillin justify all the effort that is being expended upon it, that effort must not distract attention from the other antibacterial substances which are being constantly isolated from an increasing variety of living organisms. Among these the soil bacteria are important. The properties of gramicidin and gramicidin S, obtained from soil bacteria, were noted recently in *Nature* (246, Feb. 24, 1945). Another heat-stable substance which is chemically similar to, but apparently not identical with, the gramicidin isolated by Hotchkiss and Dubos in America (see *J. Exp. Med.*, 73, 629; 1941 and other papers) has been isolated by J. C. Hoogerheide (*J. Bact.*, 40, 415; 1940, and *J. Franklin Inst.*, 229, 677; 1940) from soil bacteria. It prevents the formation of the capsule by Friedlander's bacterium, types *A* and *B*. Its chemical, therapeutic and other properties are summarized by E. McDonald (*J. Franklin Inst.*, 229, 805; 1940). Dr. V. W. Murray Wright reported that the material originally isolated by Hoogerheide from the bacteria was "very valuable and safe" for the treatment of *external* lesions in human patients. Dr. Wright (*J. Franklin Inst.*, 233, 188; 1942) also reports on a series of ninety human cases infected with Gram-positive organisms and treated with what is apparently the same substance (designated *H* 1). The organisms rapidly disappeared and healing was stimulated. G. LAPAGE.

UNITED STATES ANTARCTIC DISCOVERIES

THE work of the United States Antarctic Service Expedition of 1939–41 has been overshadowed by war and was little known in Great Britain. The volume now published (Reports on the Scientific Results. New York: *Proc. Amer. Phil. Soc.*, 89, No. 1, 1945) gives full accounts of all aspects of the expedition's work in a long series of papers, many of which are well illustrated but none of which is well supplied with maps.

This was Admiral R. E. Byrd's third expedition, but the first official United States expedition to the Antarctic for a hundred years. It was well equipped and carried a large scientific staff to its two bases, the east base in Marguerite Bay, Graham Land, wrongly called the Palmer Peninsula, and the west base at the Bay of Whales on the Ross Barrier. The first was new territory for the Americans; the second was in an area where much American work had already been done, but it seems, at the least, ungracious to reduce Scott's King Edward VII Land to a mere peninsula of Marie Byrd Land.

Discoveries made by plane and sledge journeys were noteworthy, and geological work was a feature of all land travel. Several of the most important papers in this symposium are by Lieut.-Com. R. B. Black, Com. F. Ronne, Major P. A. Siple, Major F. A. Wade, L. A. Warner, C. F. Passel, P. H. Knowles and Prof. D. Stewart. A sledge journey along King George VI Sound and a flight west of Alexander I Island carried the map west of the discoveries of the Rymill expedition. Alexander I Land is certainly an island, and west of it lies the much smaller Charcot Island. West of King George VI Sound the coast-line seems to run mainly east and west to high land in about long. 95°–100° W. South Graham Land is a plateau of some 4,000–5,000 ft. uncut by straits, and facing the Weddell Sea is the lofty edge of the George Black Range in about long. 60° W. from about lat. 72° S. to 77° S.

On the other side of Antarctica, the Edsel Ford ranges of Marie Byrd Land were well explored, and the coast-line, Hobbs Coast, continued east of Cape Rupert. Several flights across the Ross Barrier were also made. Evidence was found of several small islands under the Barrier, smaller than Roosevelt Island. There was little evidence of the Barrier having calved in recent years. It is suggested that the Bay of Whales is the meeting-place of two shelf-ice systems, on the western side from the south and on the eastern from the south-east. These systems thus cause crumbling of bay-ice in that area. No suggestion was noted of sea-level connexion between the Ross and Weddell Seas.

Some light was thrown on the problem of the relationship of the Andean structure of Graham Land with the predominant plateau structure of the greater part of Antarctica. The Rockefeller Mountains of King Edward Land and the Edsel Ford ranges of Marie Byrd Land are both a series of north-west trending folds of metamorphics and acid intrusives: "No true relationship is indicated between this unit and any of the previously described Antarctic localities". But on the whole the affinities seem to be with the Andean structure. The new land examined in the south of Graham Land is definitely Andean in structure, though the Weddell Sea coast has a definite block fault topography with much granite and slate.

Many other valuable researches are discussed in this volume. R. N. RUDMOSE BROWN.

FORTHCOMING EVENTS

Monday, October 1

BRITISH MUSEUM (NATURAL HISTORY), South Kensington, London, S.W.7, at 2.30 p.m.—Dr. J. Ramsbottom, O.B.E.: "Edible Fungi". Also on Mondays and Fridays until October 26.

ROYAL INSTITUTION (Albemarle Street, London, W.1), at 5 p.m.—Lord Rayleigh, Sir Robert Robertson, Sir Richard Paget, Mr. R. S. Whipple, Prof. W. V. Mayneord and Sir Henry Dale: Life and Work of Major C. E. S. Phillips

SOCIETY OF ENGINEERS (at the Geological Society, Burlington House, London, W.1), at 5 p.m.—B. A. P. Winton Lewis: "The Engineer and the Housing Problem".

SOCIETY OF CHEMICAL INDUSTRY, LONDON SECTION (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 7.15 p.m.—Dr. E. S. Hedges: "New Developments in Tin and Tin Alloy Coatings".

Wednesday, October 3

INSTITUTE OF WELDING (at the Institution of Civil Engineers, Great George Street, London, S.W.1), at 6 p.m.—Mr. W. K. B. Marshall: "The Fabrication of Aircraft Fuel Tanks in Aluminium Alloy containing 3% Magnesium" (Sir William J. Larke Medal Prize Paper).

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 6.30 p.m.—Mr. Eric C. Wood: "The Theory of certain Analytical Procedures, with special reference to Microbiological Assays".

Thursday, October 4

ROYAL COLLEGE OF SURGEONS OF ENGLAND (Lincoln's Inn Fields, London, W.C.2), at 5 p.m.—Dr. Leslie Foulds: "Observation and Theory in Cancer Research" (Imperial Cancer Research Fund Lecture).

CHEMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 5 p.m.—Dr. U. R. Evans: "Recent Work on Corrosion and Oxidation Reactions".

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Dr. P. Dunsheath: Inaugural Address as President.

Friday, October 5

BRITISH RHEOLOGISTS' CLUB (at the Engineers' Club, Manchester), at 11 a.m.—Business Meeting; at 2 p.m. (joint meeting with the MANCHESTER SECTION OF THE OIL AND COLOUR CHEMISTS' ASSOCIATION)—Discussion on "General Rheological Properties of Suspensions" (to be introduced by Mr. J. Pryce Jones and Mr. W. F. Carey)

ASSOCIATION OF APPLIED BIOLOGISTS (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 11 a.m. and 2.15 p.m.—Symposium on Some Agricultural Uses of D.D.T.

PHYSICAL SOCIETY (at the Physics Department, Imperial College, London, S.W.7), at 5 p.m.—Dr. D. H. Smith: "A Method for obtaining small Mechanical Vibrations of known Amplitude"; Dr. S. R. Pelc: "The Photographic Action of X-Rays"; Rev. G. D. Yarnold: "The Hysteresis of the Angle of Contact of Mercury".

SOCIETY OF CHEMICAL INDUSTRY, PLASTICS GROUP AND GLASGOW SECTION (at the Royal Technical College, Glasgow), at 7.15 p.m.—Prof. H. W. Melville: "Structure and Synthesis of Vinyl Plastics".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

TWO ASSISTANT LECTURERS IN APPLIED MATHEMATICS in the University of Liverpool—The Registrar (Oct. 1)

PRINCIPAL at a Farm Institute for Training ex-Service men, to be opened in Norfolk—Executive Officer, Norfolk War Agricultural Executive Committee, Sprowston, Norwich (Oct. 3).

DISTRICT OFFICER to the Berkshire War Agricultural Executive Committee—The Secretary, 1 Abbot's Walk, Reading (Oct. 6).

LECTURER IN ORGANIC CHEMISTRY at the Mid-Essex Technical College, Market Road, Chelmsford—Chief Education Officer, County Offices, Chelmsford (Oct. 6).

LECTURER with special responsibility for AERONAUTICAL ENGINEERING at the Technical College, Coventry—Director of Education, Coventry Local Education Authority (Oct. 8).

GRADUATE TEACHER OF ELECTRICAL ENGINEERING and allied subjects at the School of Engineering and Navigation, High Street, Poplar, London, E.14—The Education Officer (T.1), County Hall, London, S.E.1, on application form T.1/40, for which a stamped addressed envelope should be sent (Oct. 8).

LECTURER IN GEOGRAPHY at the London School of Economics and Political Science, Houghton Street, London, W.C.2—The Secretary (Oct. 8).

GRADUATE ASSISTANT to teach ENGINEERING SUBJECTS at the Stockton-on-Tees Technical School—The Director of Education, Shire Hall, Durham (Oct. 10).

One CHIEF CHEMIST (Ref. F.4816 XA), four ASSISTANT CHEMISTS (Ref. F.4817.XA), and one ASSISTANT MECHANICAL ENGINEER (Ref. C.2797.XA), in a South American spinning rayon plant—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting appropriate Ref. No. (Oct. 12).

DIRECTOR-GENERAL OF THE BRITISH PRODUCTION ENGINEERING RESEARCH ASSOCIATION—The Association, Box A.1188, *The Times*, London, E.C.4 (Oct. 19)

DEVELOPMENT ENGINEERS (copper and copper alloys), one ELECTRICAL (D.1388.XA) and one MECHANICAL (C. 2736.XA)—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting appropriate Ref. No. (Oct. 19).

DISTRICT ENGINEER (civil) for the Sudan Government—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting E.1954.A (Oct. 20).

DIRECTOR OF RESEARCH, Institution of Automobile Engineers—The Chairman of the Institution, Research Department, Great West Road, Brentford, Middlesex, marked "Director of Research" (Oct. 20).

Two DISTRICT LOCOMOTIVE SUPERINTENDENTS for the Sudan Government—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting C.2798A (Oct. 20).

PHYSIOLOGIST at the Laboratory of the Marine Biological Association of the United Kingdom, Citadel Hill, Plymouth—The Secretary (Oct. 31).

CURATOR OF VERULAMIUM MUSEUM, St. Albans—The Town Clerk, St. Albans, endorsed "Curator" (Oct. 31).

SUB-LIBRARIAN in the University Library, St. Andrews—The Librarian (Nov. 1).

DEPUTY CITY ANALYST, City and County of Bristol—The Medical Officer of Health and Professor of Preventive Medicine, Department of Public Health, Kenwith Lodge, Westbury Park, Bristol 6, endorsed "Deputy City Analyst" (Nov. 3).

JACKSON CHAIR OF ENGINEERING in the University of Aberdeen—The Secretary (Nov. 15).

RUTHERFORD MEMORIAL RESEARCH FELLOWSHIP (physics, chemistry and/or mathematics) at Canterbury University College, Christchurch, New Zealand—The Secretary, Universities Bureau of the British Empire, care of University College, Gower Street, London, W.C.1 (applications to reach New Zealand by January 31, 1946).

DEMONSTRATOR IN PHYSICS at Guy's Hospital Medical School, London, S.E.1—The Dean of the School.

CHIEF DEVELOPMENT ENGINEER to the Research and Development Department, United Steel Companies, Ltd.—The Secretary, 17 Westbourne Road, Sheffield, 10.

CHAIR OF MINING AND METALLURGY, CHAIR OF ELECTRICAL ENGINEERING, and CHAIR OF MECHANICAL ENGINEERING, University of Adelaide—The Secretary, Universities Bureau of the British Empire, care of University College, Gower Street, London, W.C.1

HEAD OF THE ENGINEERING DEPARTMENT, Municipal College, Bournemouth—The Director of Education, Town Hall, Bournemouth.

PRINCIPAL OF THE LOWESTOFT TECHNICAL INSTITUTE—The Chief Education Officer, County Education Department, County Hall, Ipswich.

LECTURER IN ELECTRICAL ENGINEERING, and LECTURER IN MECHANICAL ENGINEERING, in the Nottingham and District Technical College—The Acting Clerk to the Governors, Education Office, South Parade, Nottingham.

ASSISTANT (graduate in zoology or physiology) FOR CANCER CHEMOTHERAPY INVESTIGATIONS—Hosa Research Laboratories, Sunbury-on-Thames.

TECHNICAL ASSISTANT IN THE GEOLOGY DEPARTMENT, University of Birmingham—Prof. L. J. Wills.

ASSISTANT LECTURER AND DEMONSTRATOR IN PHYSICS at the Royal Holloway College, Englefield Green, Surrey—The Principal.

LECTURER IN PHYSICS at the Stockport College for Further Education—The Deputy Director of Education, Education Offices, Town Hall, Stockport.

GRADUATE LECTURER IN MECHANICAL ENGINEERING SUBJECTS at the Kingston Technical College—The Principal.

DEMONSTRATORS IN PHYSICS, BIOLOGY and CHEMISTRY (one each), and a TECHNICIAN, at St. Bartholomew's Hospital—The Vice-Dean of the Hospital, at Queens' College, Cambridge.

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92, Upper Circular Rd, Cal

NATURE

No. 3962 SATURDAY, OCTOBER 6, 1945 Vol. 156

CONTENTS

Page
An International Science Co-operation Service . . 401
Proteins, Amino-Acids and Peptides. By Dr. Kenneth Bailey 405
Management of a Special Library. By R. Brightman . 406
Milk Hygiene 406
Physical Conditions of the Surface of the Mesophyll Cell Walls of the Leaf. By Prof. Francis J. Lewis . . 407
Recent Developments in Air Photography. By Wing-Cdr. H. Hamshaw Thomas, M.B.E., F.R.S. . . 409
Sex Education : Aims, Possibilities and Plans. By Cyril Bibby 412
Obituary :
  Mr. W. Sydney Smith, C.B., O.B.E. . . . 414
News and Views 415
Letters to the Editors :
  Anti-*Hr* Sera.—Dr. Philip Levine . . . 418
  Effect of Tissue Extracts in controlling *Staphylococcus aureus* Infections.—Dr. Leo G. Nutini and Sr. Eva Maria Lynch, S.S.J. 419
  Differentiation between Eosinophils and Pseudo-eosinophils of Rabbits' Blood by means of a Peroxidase Reaction.—Dr. F. Jacoby. . . 420
  Cosmic Radiation Observed at the Col du Lautaret, Hautes-Alpes.—Jean Daudin 420
  Packing of Regular (Spherical) and Irregular Particles.—R. L. Brown and P. G. W. Hawksley . 421
  Measurement of High Voltages.—Dr. J. M. Meek and F. W. Waterton 422
  Anodic Deposit of Protactinium.—M. Haïssinsky . 423
  X-Ray Study of the Solution of Alkali Halides in Borax and B_2O_3 Glass Systems.—S. K. Majumdar, B. K. Banerjee and K. Banerjee . . . 423
  Harmonics in the Piezo-Electric Oscillation of a Quartz Crystal.—L. C. Tsien and H. C. Chu . 424
  Hexachlorocyclohexane as an Insecticide.—Sidney Rogerson 424
The Giant's Causeway. By Prof. Arthur Holmes, F.R.S. 425
The Film in Science 426
Tyroglyphid Mites and Human Disease. By Dr. G. Lapage 427

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AN INTERNATIONAL SCIENCE CO-OPERATION SERVICE

WHILE scientific workers may well find it scarcely less difficult than their fellow citizens to grasp as yet the full implications of the new force resulting from scientific discovery which we have seen in action in the atomic bomb, they will unhesitatingly endorse Mr. Attlee's view that a re-evaluation of the whole situation, especially in the sphere of international relations, is required. This is particularly true in respect of the exchange and dissemination of information and of the organization of defence, to both of which questions scientific men in Britain have been giving close attention during recent months. Nothing can stop the progress of research and experiment in every country; but although research will no doubt proceed in many places, the immense plants necessary to transform theory into action cannot well be constructed in countries not possessing the necessary resources. Our organization of scientific research and development, the whole system of the organization and co-ordination of the nation's resources for defence purposes, which Lord Hankey reviewed under a somewhat misleading title in his recent book, "Government Control in War", must be reconsidered in the light of this new situation.

This no doubt will be one of the prime tasks of the new Atomic Energy Advisory Committee which, as announced on August 21, the Government has set up, under the chairmanship of Sir John Anderson, to assist in dealing with the many far-reaching questions raised by this new discovery, in connexion with its international treatment and its further development in Britain, for both industrial and military purposes. This Committee is not intended to deal with policy, which no doubt will be fully considered not only by the Government itself, but also, if not by the Executive Committee of the Preparatory Commission of the United Nations, then by the Security Council, as Mr. Bevin's statement on August 16 indicated. The exchange of scientific information and of scientific co-operation is thus again to the fore, and the ideas put forward last year by Dr. Joseph Needham for the organization of an international science co-operation service acquire fresh significance.

The choice is in fact not between secrecy and disclosure, but between co-operative and competitive knowledge. It might be held a sensible precaution for the United States to hold her secret until agreement has been reached upon the form of the new world control and until the appropriate machinery has been built into the United Nations organization; but that control must be based on the pooling of knowledge, upon the recognition that, as the Archbishop of Canterbury pointed out, it is the duty of men of science to explore and to find out with all the abilities they have, and to extend the knowledge of this universe. That duty can only be discharged while there is the fullest communication between scientific men of all countries; and although there may be room for much discussion as to the form the control now required should take, it must be recognized from the start that full freedom of scientific intercourse is a first condition. Without that there can be neither effective control in seeing that this discovery is not turned to destructive ends, nor the best use made of it for peaceful purposes.

One of the first steps to be taken is thus, as Sir Henry Dale suggested in his letter in *The Times*, the encouragement of the fullest possible publication of the results of scientific research and of the full freedom of science for which he pleaded. It is not merely that progress in science really depends on such freedom of intercourse; from the point of view of world order and security, such freedom would also be a useful means of indicating danger points. Restrictions or refusal to participate would not be easily concealed from the scientific community; and once the existence of such an attitude was established, the world organization should be able to deal appropriately with the situation before it became unmanageable. Furthermore, the historical survey of the scientific discoveries which led to the idea of the atomic bomb contained in the Statement issued by the Department of Scientific and Industrial Research on August 12, 1945, well illustrates the truth that scientific effort proceeds on parallel lines in different countries, and effective contact and intercourse between the scientific men of the United Nations should in itself be a safeguard against any sudden advance elsewhere, the application of which might endanger the peace of the world.

Dr. J. Needham, writing from Chungking, has now prepared for private circulation a memorandum on the place of science and international scientific co-operation in post-war world organization, in which he reviews the reception of his earlier proposals and discusses their incorporation in a United Nations organization such as that which was recently considered by the Conference of Allied Ministers of Education. Prof. A. V. Hill's address on "Scientific Co-operation within the British Commonwealth" before the Royal Empire Society on January 31 (see *Nature*, 155, 373; 1945) elaborated proposals for a more limited field, but with their bearing on international scientific co-operation clearly in mind. The recent visit of British and other men of science to Moscow for the anniversary celebrations of the U.S.S.R. Academy of Sciences has provided further evidence of the concern and desire of scientific men everywhere for fuller and free international contacts.

The dependence of all modern world civilization on applied science must find its expression in the sphere of international relations, and Dr. Needham notes that this desire is more strongly expressed the further one goes away from the great scientific and industrial centres of Europe and the United States. One reason for this is, as he shows in his memorandum, that the picture of world science looks very different when seen from Rumania, Peru, Siam or China, where it may be very difficult for one man of science to establish contact with another in a different part of the world. It is particularly the scientific workers and technologists in the far larger regions of the world outside Western Europe and North America who need the help of an international science co-operation service.

Dr. Needham points out that such a service should be directed and limited to doing those things that are not being done, and cannot be done in other ways. It must also avoid the danger of a paper organization incapable of functioning effectively, and undue bureaucracy through failure to select the right staff. Adequate office management would avoid the first danger, and full participation by scientific men themselves the second. He should also have added, however, that no new organization should be established where the development or modification of existing organizations would serve.

Since these proposals were advanced last year, draft proposals for an educational and cultural organization of the United Nations have been published (see *Nature*, Sept. 1, p. 263). The purposes of this organization are "(1) To develop and maintain mutual understanding and appreciation of the life and culture, the arts, the humanities and the sciences of the peoples of the world as a basis for effective international organization and world peace". The principal functions of the organization would be to assist the free flow of ideas and information among the peoples of the world through schools, universities and other educational and research institutions, libraries, publications and the Press, the radio and motion picture, international conferences and the exchange of students, teachers and all other representatives of educational and cultural life, with special attention to the exchange of information on major educational and cultural developments, including advances in scientific knowledge. They also include fostering the growth of educational and cultural programmes which give support to international peace and security, and conducting and encouraging research and studies on educational and cultural problems related to the maintenance of peace and the advancement of human welfare.

The activities thus contemplated cover most of the twenty-four specifically listed in the draft cited in Dr. Needham's memorandum, and scientific activities are more implicitly covered, though the restoration of physical facilities including laboratories and equipment and scientific libraries in the liberated and ravaged countries is not mentioned. Since, however, the word 'culture' does not possess in all countries the wide connotation it has in the United States, Dr. Needham is on firm ground in insisting that the word 'science' should appear in the actual title of the organization, and in suggesting that it should be termed the United Nations Educational, Scientific and Cultural Organization. Moreover, the Organization should cover both pure and applied science, which cannot be separated.

Dr. Needham sets forth thirteen aims for the scientific division of the new Organization which overlap with those already mentioned but cover the field of science more adequately, and have much in common with the agenda Prof. A. V. Hill suggested for the Empire Scientific Conference. First, there is the general aim of promoting international scientific co-operation in all its aspects. Next, he puts organization of the better exchange of scientific information and research services between scientific men and their organizations in the different countries. Here Dr. Needham refers to the enormous task of seeing that the information actually published by government scientific organizations reaches those who need it, both far and near. In this connexion his work in China has clearly impressed upon him the need for increasing the availability of scientific periodicals, both current issues and the back runs of the more important periodicals. Besides the question of reproduction which may be involved here, there is the exchange of reprints, and Dr. Needham suggests that a central stockpile might be of great value to scientific workers by facilitating distribution.

In elaborating this point, Dr. Needham ventures into a highly technical field; but it may well be argued that some such organization as he advocates would prove the best means of securing an objective study of the problems and encouraging, not the development of a number of new *ad hoc* organizations, but rather the expansion of existing organizations so that they could serve adequately the needs of to-day. He also suggests in the same connexion that much help could be given to scientific workers by arranging for the wider use of special apparatus only available at certain places, while a specific aim should be that of assisting the free flow of essential research apparatus, chemicals and equipment across national frontiers. This function would involve assisting a wide distribution of the catalogues of firms producing scientific equipment, and possibly some assistance in the matter of customs dues and procedures. Some of these points have already been emphasized by the Committee on Scientific Equipment of the Conference of Allied Ministers of Education. As one of three short-term aims, Dr. Needham mentions the elaboration of a plan for utilizing surplus war material and equipment suitable for use in research and its transfer to the more scientifically backward countries.

Another aim would be the maintenance of contact between government organizations concerned with science, pure and applied, when necessary, and advising government and diplomatic personnel on scientific matters. This applies to the smaller Powers particularly, for even if the practice of appointing scientific attachés in the embassies of the larger Powers becomes established, the smaller Powers may well lack the personnel to make such appointments. Again, the need is stressed for assisting the free flow of scientific books, periodicals, manuscripts for publication, translations, abstracts, etc., across national frontiers, and especially between world regions of widely different linguistic pattern. Here he has in mind both encouraging the publication of scientific results in the major scientific periodicals in the better-known languages, and also the rationalization of the present system of abstracting scientific publications. An International Science Co-operation Service should be able to do something to prevent the dissipation of scientific publication on purely nationalistic grounds. t might assist the effort which the British Commonwealth Science Committee contemplates in its report for a common abstracting service for the English-speaking nations, and develop this ultimately into a central abstracting organization issuing the abstracts in the three or four main world languages simultaneously.

Realization of such plans at present lies far ahead, but progress is scarcely possible except through an organization of the type Dr. Needham has in mind. Even within a single country, there is still much parochialism among scientific workers to be broken down before co-operative enterprises in such fields as abstracting can achieve full success. Probably Dr. Needham's next objective, assisting the free flow of scientific workers across national boundaries, is one where the organization he suggests might function with more immediate effect. Dr. Needham quotes Sir David Rivett, Dr. Coumoulos and Prof. J. B. S. Haldane to illustrate the importance of this objective, and refers also to such matters as the preparation of scientific expeditions in zoology and astronomy, and for the investigation of the natural products of interesting parts of the world where local effort would be unable to finance such projects. Dr. F. W. Went's proposal for the organization of temporary research groups in specific topics in fields such as genetics, cytology, physiology and morphology is a further example of how valuable such an international science co-operation service might prove.

Overlapping with this aim, Dr. Needham suggests the promotion of plans for international collaboration in research, and has in mind both close contact with the international scientific unions which, in such sciences as astronomy, geophysics, geodesy and radio physics, have been outstandingly successful in the past, and the establishment of similar bodies for other sciences, as well as encouraging the activities of such organizations as the International Committee on Zoological Nomenclature. He illustrates his point by showing how an international science co-operation service could help in rapidly supplying contacts needed in research and by rendering the dissemination of scientific information less haphazard. This aim would also cover the preparation and maintenance up to date of a register of scientific institutions of all kinds and of their staff members and specialities.

Again, the new organization would support all international activities of the various national academies of science, and assist the work of other international organizations, such as the United Nations Food and Agriculture Organization and Relief and Rehabilitation Administration, the International Labour Office, etc., in scientific questions. Such development would be greatly facilitated by the development of the expected science co-operation service of the British Commonwealth after the War and like bodies, the International Resources Office, or the International Development Authority called for at the Bretton Woods Conference. On the other hand, the organization suggested by Dr. Needham might be able to combine into one body some of the smaller international scientific bodies such as the United Nations Standard Co-ordinating Committee, the World Power Conference, the International Fisheries Board, and also provide central secretariat facilities for the international scientific unions and congresses.

From Dr. Needham's experience with the British Council Scientific Office in Chungking, and from the work of the United States Interdepartmental Committee of Cultural and Scientific Co-operation with the American Republics, he is able to supply concrete examples of the kind of work which the organization he suggests might do. Furthermore, while the work of the organization would chiefly be related to that of the Social and Economic Council of the United Nations, in one matter at least it would be related to that of the Security Council. Dr. Needham suggests that the organization should be concerned with the control of the activities of scientific workers in the ex-Axis countries so as to prevent the building up of war potential while permitting the renaissance of scientific thought which must have a place in the re-education of these peoples. With an international science co-operation service, it should be almost impossible for the significance of such developments as the Haber ammonia synthesis to be overlooked, and this factor has a vital bearing on the elaboration of any plans for the control of atomic energy.

As to further association of the organization with industrial activity, Dr. Needham is a little vague. He thinks that some help might be offered in the simplification of world patent law and that by means of such an organization the maximum goodwill could be focused on the development of the backward countries. Dealing with the probable cost and structure of the proposed organization, from the cost of the British scientific office in Washington and in China and the United States Cultural Division of the State Department (Far East Section), he suggests that the annual budget should be about three million dollars, providing for a liberal number of field offices. It is essential, however, that the scientific organization be not radically understaffed or starved of funds, and the headquarters' secretariat must be supported by a resident staff in the more backward countries, where the prestige of science is weak and the influence of local politicians with no understanding of science is strong. Not more than two or three of the scientific representatives in such a field office need be of outside nationality, and for some regions a field office could cover several national entities or domains.

Dr. Needham is not pessimistic as to the possibility of securing the right staff, and points to the fund of wisdom and experience which could be drawn upon by utilizing men in the five-year period after retiring age. The business of the scientific liaison officer, he emphasizes, is not necessarily to know the answer; but to know where the answer can most probably be obtained. He also emphasizes the need for assuring the officials of the organization of some kind of diplomatic status, with guaranteed facilities for transport and communication.

Dr. Needham has been at some pains in formulating his scheme to avoid the weaknesses in the International Institute of Intellectual Co-operation, but although it may be assumed that the principal place for science in the international scheme is the United Nations Educational and Cultural Organization, with the title modified as suggested, many scientific men will be working with other functional organizations, such as the Radio Communications Organization, the Civil Aviation Board, the Food and Agriculture Organization, the International Health Organization. Accordingly, it has been proposed that a scientific body might be introduced at a higher level than any one of the functional organizations; so Dr. Needham suggests that the United Nations should include, as a counterpart of the Economic Commission and the Social Commission, a Scientific Commission and a Scientific Secretariat. The Commission might consist of about a dozen eminent men of science of the older generation, and the secretariat of a score or so younger men of science, mostly on a short-term service basis. This Scientific Commission of the Economic and Social Council would provide an easy means of linking the work of all scientific men in the functional organizations; but Dr. Needham himself appears to lean rather to the idea of an Educational, Scientific and Cultural Organization, functioning on the lines already indicated, and worked out in detail by a world conference of science; such a conference has already been recommended by the National Academy of Sciences of the United States. Nevertheless, although most of Dr. Needham's suggestions are to be found in current discussions on problems of scientific relations, it may well be open to question whether the time is really ripe for such a world conference. So far as the British Commonwealth is concerned, these questions will largely be covered by the Empire Science Conference to be called next summer by the Royal Society, and the improvement of scientific co-operation and communications within the British Commonwealth is an essential factor in promoting any wider schemes.

What appears to be of the first importance at the present moment is to see that the full fruits of wartime experience are reaped, and that machinery for co-operation for war purposes, whether within or without the British Empire, which has proved its value, should not be thrown away. To develop and utilize fully existing organizations rather than to elaborate fresh organizations should be a guiding principle. It is true we may well hope for the establishment of an Indian Scientific Office with an Indian Scientific Liaison Service, and the position with regard to the Middle East Supply Centre may require careful watching if the valuable scientific work already initiated under it is not to be jettisoned. That in itself is a matter for international collaboration, and the Empire Science Conference is unlikely to disregard the work of the British Central Scientific Office in Washington, the Scientific Office of the British Council in China, or the experiment with scientific attachés which Australia has initiated. Furthermore, those considerations of imperial defence to which Prof. A. V. Hill referred in his address to the Royal Empire Society on January 31 have been powerfully reinforced by the advent of the atomic bomb; and policy in this matter cannot be worked out in isolation. Dr. Needham's proposals may appear premature in some respects, but between now and the meeting next summer of the Empire Scientific Conference there should be clear thinking among scientific workers of the Commonwealth as to the precise ways of improving means of communication and co-operation within and without the British Empire, and the extent and delimitation of any new organization to be established for such purposes. Such consideration must necessarily take account of the draft proposals for a United Nations Educational and Cultural Organization, and a decision reached as to how far such an organization can serve the needs of science, what modifications, if any, are required in title or in structure, and whether or not scientific organizations can usefully co-operate. Dr. Needham has at least challenged the constructive thinking which is essential in order to seize the opportunities of the post-war world.

PROTEINS, AMINO-ACIDS AND PEPTIDES

Proteins, Amino-Acids and Peptides as Ions and Dipolar Ions

By Edwin J. Cohn and John T. Edsall, with chapters by John G. Kirkwood, Hans Mueller, J. L. Oncley and George Scatchard. Pp. xviii+686. American Chemical Society Monograph Series. (New York: Reinhold Publishing Corporation, 1943.) 13.50 dollars.

THE misfortunes of war have rendered this impressive book, published in 1943, inaccessible in Britain until recent months. No shorter description is possible than to say it is worthy of those great men to whom it is dedicated, Bate Hardy, Loeb, Osborne and Sørensen.

The book is wholly devoted, except for one chapter, to physico-chemical aspects of proteins and their simpler constituents, and, until very recent times, such books have been exceedingly few. The earlier ones by Robertson (1920), Loeb (1922), Pauli and Valkó (1933) were of classical calibre (this one no less), and they were for the most part an interpretation of those properties of proteins directly dependent upon the ampholytic character of the molecule; little was known of the size and shape of the protein molecule. In the last decade, however, we have seen the fruition of Svedberg's monumental researches in this latter field, researches which reoriented the type and scope of physico-chemical research, and we now mark a point at which much is known of what we might call the morphology of the protein molecule, and almost nothing of its fine structure. The present volume incorporates this newer knowledge, yet the emphasis, like that of its antecedents, is upon those properties of proteins arising from their dipolar ionic character. This does not imply a bias: it merely recognizes a fundamental character which makes the protein molecule the great architect of biological reactions.

The outstanding feature of the book is that it presents, both in trend and treatment, the individual approach which Prof. Cohn and his colleagues have consistently followed in the long series of papers from the Harvard laboratories; that is, the properties of proteins reflect in large degree the properties of the simpler peptides and amino-acids, and are explainable, also in large degree, from the more straightforward studies on these simpler compounds. The first part, therefore, is devoted to amino-acids and peptides, thus: spectroscopy and dipolar ionic structure; thermodynamics and simple electrostatic theory; dipolar ions and acid-base equilibria; relations between acidity and chemical structure; dielectric constants and dipole moments; apparent molal volume, heat capacity, compressibility and surface tension; solubility in water and in organic solvents; interactions between organic solvents and dipolar ions; interactions between amino-acids and peptides, etc.; interactions between ions and amino-acids; theoretical interpretation of the properties of dipolar ions in solution.

The second part is devoted to the proteins: structural basis from analysis and proteolysis; X-ray diffraction studies; amino-acid composition; density and apparent specific volume; osmotic pressure and molecular weights; translational diffusion; sedimentation and diffusion; proteins as acids and bases; rotary Brownian movement; electric moments and relaxation times; solubility of proteins; interactions of proteins with ions and dipolar ions; theory of electrophoretic migration.

It must be admitted that the book, though lucidly written, will not be readily assimilated except by the physico-chemical expert, and no review can dismiss that large section of less specialized readers who must enlarge their more purely chemical or biological interests. For the broad mass of workers in the biochemical field—and there are few aspects of biochemistry which do not touch upon and require some knowledge of the properties of proteins—may be deterred by the rigorous mathematical treatment which a book of this nature must embrace. Yet it is important that this section of biochemists should understand, to take one obvious example, the factors governing the solubility of a protein, a knowledge facilitating all preparative and purification techniques in the field of proteins 'proper', hormones, enzymes, viruses, immuno-chemistry and the rest. How far then does the book fulfil the needs of this class of reader? Certainly, Chapters 3 and 12 by Scatchard and by Kirkwood (thermodynamics and simple electrostatic theory; properties of solutions of dipolar ions), and Chapter 25 by Mueller (theory of electrophoretic migration) will not be appreciated and their usefulness must be rather limited. On the other hand, most other chapters are characterized by an unassuming approach and show the adaptation of simple laws to the study of complex problems. Of this, Chapter 4 (dipolar ions and acid-base equilibria) and Chapter 6 (dielectric constants and dipole moments), both by Edsall, are two examples. The authors do indeed create an awareness that they have been sensible of the needs of the less specialized reader, and strike a nice balance between descriptive and mathematical formulation. With a little perseverance, therefore, this class of reader will reap a rich harvest.

We have noted the main emphasis of the book, namely, the dipolar ionic character of proteins. One of the most important sections here is the interaction of proteins and ions, and Chapter 24 reveals that some aspects are not fully understood; particularly the extreme insolubility of some protein cations in presence of mere traces of salt. Again, the interaction of protein with protein must be of great importance in physiological systems, yet few studies have been made. Among other chapters, protein structure is summarily treated, and only a few aspects of denaturation. The treatment of the amino-acid composition of proteins in one chapter is rather inadequate, and the description of some analytical methods, at a time of expansion into the newer chromatographic and biological methods, is not of permanent value. The supplementary index, tabulating the page reference of various types of data for certain amino-acids, peptides and proteins, is extraordinarily useful. KENNETH BAILEY.

MANAGEMENT OF A SPECIAL LIBRARY

Manual of Special Library Technique

With Particular Reference to the Technical Special Libraries of Commercial and Government Establishments. By J. E. Wright. Pp. viii+104. (London: Association of Special Libraries and Information Bureaux, 1945.) 8*s*. 6*d*.

THE discussions devoted to the organization and problems of special libraries and information departments have always been among the most popular at the annual conferences of the Association of Special Libraries and Information Bureaux, and the interest which was aroused by the symposium of papers on the organization of technical information services in industry arranged by the Society of Chemical Industry in October 1943 is further evidence that Mr. Wright's book should have a wide appeal. In contrast to Mr. J. L. Thornton's book on special library methods published in 1940, which was largely a survey of university and university college libraries and those of learned societies and institutions, Mr. Wright's book is a manual of practice, and has particular reference to the technical special libraries of commercial and Government establishments. Within its limits it is a thoroughly competent piece of work. The right points are emphasized and although some of its chapters, for example those on indexing and on classification, may be rather too condensed, it should meet a recognized need. While the manual contains little that is new, Mr. Wright has brought together information which a beginner might not easily trace, and such beginners, as the Association has discovered, are by no means rare.

Most libraries maintained by an industrial firm begin as a small collection of books in a manager's office, with some inflow of trade and other periodicals. Chemical and engineering firms and some others may have enough research interest to acquire some bound runs of the periodicals of the learned societies, and sooner or later the expansion of this nucleus requires a separate room. As soon as even only a small separate room is required, someone is needed to handle the periodicals and take care of the collection, and by this time some special abstracting or card-indexing of particular information may have been requested by busy technologists. The part-time amateur or casual attendant thus finds himself or herself blossoming into a full-time works librarian, and however qualified in knowledge of the manufacturing or scientific side of the firm's business, usually lacks, and is ignorant of, any literature of librarianship as a vocation. Mr. Wright's book is a valuable addition to those published remedies for growing pains of which such beginners are often unaware, and the chapters on the inquiry desk and on information service, based on a paper given to the Association's Conference in 1942, should be particularly appreciated.

For a short manual this book is well balanced, but it would have been better not to have brought in so much reference to ephemeral conditions. In what is presumably intended as a standard and permanent manual, matter relating to war hindrances, if included at all, would better have been relegated to an appendix and discarded at the appropriate time from the subsequent and enlarged editions which will doubtless be called for. The section on patent specifications is excellent, but could with advantage be amplified to include information regarding United States, German, Swiss and French Patent Office publications. In regard to questions of library co-operation, however, Mr. Wright might have made the position of the library of an individual firm a little clearer. In practice, firm's libraries may and often do respond generously to requests for assistance, but such requests are considered on their merits; and it is not clear why Mr. Wright suggests that it is not possible to co-operate in one matter while refusing to co-operate in others. The point is that a firm's library, by its constitution and purpose, cannot offer service outside in the way that a library under public auspices, such as a university library or a Government library, might be expected to do, and this circumstance has to be kept carefully in mind in formulating any large schemes of library co-operation.

R. BRIGHTMAN.

MILK HYGIENE

Bacteria in Relation to the Milk Supply

Third Edition. By G. H. Chalmers. Pp. vii+272. (London: Edward Arnold and Co., 1945.) 8*s*. 6*d*. net.

THE scope of this book has now been clearly defined by this third edition. The book in its present form will without doubt find its greatest value in the hands of students of the methods of milk production, processing and distribution, who require some knowledge of elementary bacteriology. As such the book is extremely valuable, since it is the only modern British text on the subject of hygiene applied to milk handling in all its stages. The section on the control of dairy plant is particularly well done, and collects together all the subject-matter otherwise scattered throughout various text-books, research papers and Government pamphlets.

It must be understood, however, that the book is in no way a text-book of bacteriology, and serious students of dairy bacteriology cannot rely on this volume for any great help in their subject apart from the particular aspects of the hygienic control of production and processing methods and plant. From the systematic point of view it is to be regretted that the existing confusion over nomenclature is increased by such terms as *B. coli*, *B. welchii*, *B. subtilis*, *B. tuberculosis* and *B. cyanogenes*, organisms which, by usual custom, represent five separate genera. It is also perhaps a pity that there is, in the technique of the plate count and coliform test, slight deviations in details from those published by the Ministry of Health. Lack of uniformity in such details renders more difficult the reproducibility of tests already difficult to reproduce.

One further small point: the value of this generally recommended book would be greatly enhanced by the addition of more references to work mentioned in the text.

PHYSICAL CONDITIONS OF THE SURFACE OF THE MESOPHYLL CELL WALLS OF THE LEAF

By PROF. FRANCIS J. LEWIS

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MOST of the extensive work carried out during the last half-century on transpiration has been mainly concerned with stomatal behaviour and the amount of water vapour passing out from the stomata during their period of opening. Very little attention seems to have been given to the nature of the outer surface of the mesophyll cell walls through which the water vapour passes, and through which at the same time active gaseous exchange takes place.

It has been stated that the surface of these walls is either moist or covered with a thin film of water from which evaporation into the intercellular cavities of the mesophyll takes place. It seemed of interest to investigate the properties of this surface more critically in the light of these suggestions.

The experimental method first employed consisted in cutting leaf strips parallel to the lateral veins. If such strips are suspended vertically with one edge in contact with water, no entry of water takes place into the capillary system, and the same result may be observed if the whole strip is immersed in water. It makes no difference whether the experiment be carried out in light or darkness, and all attempts to induce the entry of water into the capillary system proved unsuccessful.

Experiments were then performed to determine the possibility of the entry of other liquids under similar conditions. Leaf strips suspended vertically over a number of organic liquids, and with the cut end just in contact showed a ready entry of such liquids into the air space system. For this purpose benzene, chloroform, ether, petroleum ether, acetone, essential oils, olive oil and pure medicinal paraffin have been used.

In all these cases immediate entry occurs, the liquid rushing with great velocity into the capillary system of the mesophyll. In the case of benzene, chloroform, ether and petroleum ether a vertical rise of 2 cm. may be obtained in 60 sec., and the rise goes on at a progressive rate until the inflow reaches the upper edge of the strip.

The entry of essential oils, olive oil and paraffin is somewhat slower; but even with paraffin a vertical rise of 5 mm. can be observed to occur in approximately 5 min., and a more rapid rise with the lighter oils.

Direct microscopic observations of the mesophyll surface in relation to the flow of liquids seemed desirable and were carried out in the following manner. The leaf of *Ficus elastica*, by suitable manipulation, can easily be torn transversely, so that considerable areas of the mesophyll are exposed. The lower epidermis with the lower hypodermis readily splits away from the upper portion of the leaf. If the operation be carried out rapidly, no injury to the cells takes place except the individual cell ends of the spongy parenchyma next to the hypodermis. A strip as large as desired, up to 2 cm. in length and breadth, can then be cut off and placed on a slide under the microscope. In this way the whole depth of the mesophyll can be examined under a magnification of 100 or more, and an excellent view of the space system and the small lateral veins be maintained.

A drop of water placed on this surface remains suspended like a lens on the summits of the mesophyll cells and shows no disposition to spread over their surface into the capillary space system. The drop can be enlarged so that it covers the whole strip, but the intercellular spaces still remain non-infiltrated. When a drop of the organic liquids mentioned earlier is used in the same way, instant entry into the intercellular spaces occurs. All these liquids, except medicinal paraffin, have the disadvantage of being toxic and rapidly killing the cells with which they come into contact. While the phenomena to be described do not vary essentially whatever liquid is used, the microscopic observations here described relate solely to the use of pure medicinal paraffin. The use of this hydrocarbon further had the advantage of its behaviour being easily followed, while the entry of the other liquids is so rapid that it cannot be followed by the eye.

When a drop of paraffin is placed at one end of the leaf-strip with the mesophyll surface exposed, the oil immediately penetrates the capillary system. Two advancing fronts can be observed. From the edge of the drop a stream comes out which cascades down into the air space system, and this is followed by the main wave. The outflow cascading down into the air spaces is followed by the main oil wave at a distance of approximately 1 mm., and the oil thus travels the length of the exposed mesophyll in this fashion. When a drop of water is placed about the middle of the strip and oil added at one end of the strip, the oil travels along in the manner described until it comes to the water, and the initial oil wave trickles into the air space system below the water lens and continues its path on the further side.

From these observations it seems clear that while water will not flow over the surface of the mesophyll cell walls or to fill the air spaces, a number of organic liquids do so, and the phenomena can be followed by the use of a non-toxic hydrocarbon such as pure paraffin.

Experiments with Emulsions

If a small quantity of water be shaken up with a much larger amount of paraffin so that the water droplets are of the order of about 0·001 mm. in diameter, and the paraffin with water droplets be placed at one end of a strip of exposed mesophyll, the oil enters the air space system carrying some water droplets with it. It sometimes happens that a water droplet comes into contact with one of the fine veins. When this happens the water droplet appears to adhere to the surface of the vein, often sends out an arm or narrow outflow on one or two sides, loses its spherical shape, becomes flattened, diminishes in size and finally vanishes, being absorbed into the vein. When such a water droplet comes into contact with a mesophyll cell, no change takes place, and, in the absence of a local current of oil sweeping it away, it remains unchanged in position.

When an emulsion of a small quantity of benzene in water is used the behaviour of the mesophyll can be observed microscopically. If leaf-strips be placed in such an emulsion and the containing tube be kept slowly agitated, the ends of the leaf-strips become infiltrated with benzene and the turbidity of the benzene-water almost disappears owing to the absorption of the larger droplets of benzene into the mesophyll air space system. If a similar emulsion be made with paraffin and water and the same conditions be observed, the ends of the leaf-strip become oil-infiltrated. The finest droplets of oil are not absorbed, but only a slight turbidity of the emulsion remains, due to the presence of microscopic droplets.

When a leaf-strip with the mesophyll exposed is prepared and quickly placed on a slide under the microscope, and covered with a cover-glass, moisture immediately collects on the under surface of the cover-glass. It forms at first a system of microscopic polygonal strands of water, giving a minute shagreen aspect to the surface of the cover-glass when viewed under a magnification of 100. After a few minutes the system tends to coalesce. If now water is run in under the cover-glass, it immediately penetrates between the wet cover-glass surface and the mesophyll surface, but does not flow down into the air spaces of the mesophyll. If a drop of oil is placed in contact with the edge of the leaf it immediately passes into the inter-space from end to end of the leaf-strip and is bounded above by the water film still adhering to the cover-glass which, owing to slight inequalities of the surface of the mesophyll, is distant 0·01–0·001 mm.

From these observations it appears clear that while the mesophyll is passing off water vapour rapidly into the air, and this can be condensed on the cover-glass surface in its immediate proximity, the cellulose walls from which the vapour proceeds cannot be wetted, nor does any condensation of water occur on this surface. Under these conditions when oil is presented to the cellulose walls, it immediately flows over them and fills the capillary space.

Infiltration of the Air Space System under Pressure with Dyes

Infiltration under a pressure gradient showed that different dyes have quite dissimilar effects. For example, a solution of Orange G filled the interspace system and coloured the whole infiltrated portion. The same treatment with Methylene Blue resulted in the whole of the dye being taken out of the solution at the point of entry while the clear water proceeds and fills the interspaces. Several preliminary trials of dyes taken at random revealed totally dissimilar effects in different cases, and it was resolved to make an extended series of experiments with a number of biological dyes.

The terms acid and basic dyes, while used frequently in dyeing processes, are sometimes misleading, and from a chemical point of view may be valueless. Every dye contains at least one group of atoms known as a chromophore which is regarded as being responsible for the colouring properties of the compounds in which it occurs. Some chromophores have a basic character and others are acid. On this basis dyes can be classified into acid and basic regardless of the solutions in which they occur. With these facts in mind, all water-soluble dyes available at the time were tested in regard to their behaviour to the surface of the walls of the mesophyll cells by infiltration under a pressure-gradient into the air space system. As a common standard a solution of 1/1,000 gm. mol. was used. The difference in behaviour between the two types of dye can be illustrated by the detailed description of the results given by a basic dye such as Janus Green and an acid dye such as Orange G. When a leaf is infiltrated with Janus Green the whole of the dye-stuff in solution is retained or absorbed on the surface of the mesophyll cells at the point of entry, while the water uncoloured by any dyestuff passes on and fills the interspaces of the mesophyll. The usual method adopted was to cut the leaf in half transversely, connect the cut petiole with a vacuum pump and place the leaf in the dye solution. In this case the whole of the dye-stuff in the solution passing in is adsorbed on the surface of the mesophyll cells within less than a millimetre from the edge of the leaf, while in less than 45 sec. the whole of the rest of the leaf becomes filled with water free from dye. Some objection may be taken to the fact that the solution passes into the space system over a front of cut and injured cells. To avoid this the whole uninjured leaf was submerged in the dye solution, the chamber exhausted. On restoration of atmospheric pressure infiltration takes place from the cut end of the petiole through the air spaces in the cortex. No infiltration takes place through the xylem strand. With this treatment exactly the same phenomena can be observed, for the whole of the dyestuff is adsorbed on the mesophyll walls in a small patch near the base of the leaf while water entirely free from dye fills the interspaces of the lamina. It thus makes no difference whether the dye solution enters the cut edges of a leaf or enters through the cortical interspaces from the petiole; immediate adsorption of the dye takes place in both cases. Microscopic examination shows that the adsorption of the dye is not due to staining of the cell contents but to an actual deposition on the outer surface of the walls. It can further be shown that the dye-stuff enters into a strong combination with the cell wall surface. If the coloured areas of the mesophyll are exposed and placed in water no portion of the adsorbed dye goes into solution; the dye remains permanently held on the surface. Immersion in acetone renders the adsorbed dye soluble and after a short time it may all go into solution and the original green colour of the mesophyll be restored. It is then clear that a dye with a basic chromophore such as Janus Green is strongly adsorbed and held on the outer surface of the cell walls.

If a dye with an acid chromophore such as Orange G be taken, an entirely different set of phenomena occurs. Infiltration results in the dye solution filling the interspaces, and the whole of the infiltrated area takes on the colour of the dye, the outer surface of the walls showing no adsorption of the dye. If now the leaf be allowed to clear itself of the water of the infiltrated solution, which it does in less than one hour in sunlight, the dyestuff is left in irregular patches on the surface of the walls. If the patches are exposed and placed in water the deposited dye immediately goes into solution, showing that it is not held or adsorbed on the surface.

The following dyes with a basic chromogen have been tested: Janus Green, Methylene Blue, Neutral Red, Safranin, Rosanalin, Methyl Violet, Crystal Violet, Methyl Green, Iodine Green, Rhodamine B. These all show the same strong adsorption of the dye by the outer surface of the mesophyll cell walls as has been described for Janus Green. Stains with an acid chromogen such as Orange G, Acid Fuchsin, Methyl Blue, Aniline Blue, Eosin, Erythrosin, all show the same features described in detail for Orange G.

Interesting features are found when the infiltration contains in solution both an acid and a basic dye. In this case the basic dye behaves as described in detail for Janus Green, while the acid dye behaves in a similar fashion to Orange G; so that the leaf is wholly coloured by the acid dye, which enters the interspaces of the mesophyll, while the basic dye is taken out of solution and adsorbed on the surface at the point of entry.

The acidity or the alkalinity of the dye solution makes no difference to the results; the adsorption or the non-adsorption appears to depend entirely on the acid or on the basic character of the chromogen group of the dye.

Action of Fatty Acids on the Wettability of the Cell Wall Surface

Numerous experiments have been carried out with the view of rendering the wall surface wettable by water.

Water containing cane sugar in extremely low concentration has been infiltrated into the air spaces and the leaf allowed to clear itself in sunlight by transpiration through the stomata. This gave no result as water did not enter the air spaces when one edge was placed in contact with water. The use of glycerine also gave no result.

The use of sodium taurocholate suggested itself as an agent for decomposing and penetrating mono-layers of protein. A leaf strip placed vertically in contact with water containing a minute proportion of sodium taurocholate (between 1/100,000 and 1/200,000) immediately showed a rise into the mesophyll spaces and the infiltration proceeded up the strip in the same manner as pure paraffin, but more slowly. After entering for some distance (10–20 mm.) the infiltration stops when a broad band of yellowish brown appears at the margin of infiltration. No further entry of water occurs beyond the band.

At first, experiments with sodium taurocholate showed a ready entry of the water, in other trials it was slight or did not occur at all. Further investigation showed that the *p*H of the solution was important. Solutions decidedly on the alkaline side were inoperative, while a *p*H of 6 and below renders the action certain.

Microscopic observations with sodium taurocholate were carried out on the mesophyll exposed by tearing in the manner described earlier.

If a glass needle be wetted with water containing a slight concentration and a droplet placed on the surface of the mesophyll, after a short interval the water globule begins to spread over the surface and eventually sinks into the lower interspaces in the same way as pure paraffin.

The above observations were carried out on a great variety of leaves. For experiments in which the lower epidermis had to be detached such leaves as *Hyocyamus muticus*, *Ficus elastica*, *Morus*, *Canna*, *Ricinus*, *Malva*, *Pancratium*, *Caryota* proved very suitable. *Hyocyamus* possesses a leaf in which nearly the whole lower epidermis can be peeled off in one operation, leaving the mesophyll cells quite uninjured below. The age of the leaf also influences the ease with which these manipulations can be carried out.

The preceding observations show: (1) that the outer surface of the mesophyll cells are highly hydrophobic; (2) that they are quickly covered by a liquid hydrocarbon; (3) on infiltration with water under a pressure gradient the liquid in the air spaces is quickly cleared when the leaf is placed in strong light, and there is no adhesion to the surface by liquid water; (4) the surface of the walls shows strong adsorption to certain dyes dissolved in water; dyes so adsorbed possess a basic chromophore; dyes having acid chromophores show no adsorption; (5) the hydrophobic nature of the surface of the cell wall is destroyed by sodium taurocholate, which has a lysic action on the protein mono-layers of blood corpuscles.

RECENT DEVELOPMENTS IN AIR PHOTOGRAPHY

By WING-CDR. H. HAMSHAW THOMAS, M.B.E., F.R.S.

THE value of air photography for military intelligence and map revision became recognized early in 1915, and during the War of 1914–18 great progress was made in the design of aircraft cameras. Long series of overlapping pictures were obtained, stereoscopic examination of prints was commenced, and many of the types of information obtainable from suitable photographs were recognized. After that War, the use of this method in survey and map revision was studied[1], and surveys of large areas were made, especially in Canada and the United States. In some places air photographs were employed for scientific studies as I suggested in *Nature* in 1920 [2], and results of importance for geologists, foresters, civil engineers and archæologists have been obtained.

The outbreak of war in 1939 found Great Britain, however, with very inadequate preparations for air photography as one of the chief sources of war intelligence. But during 1940 an organization was brought into being in which many professional men of science were enrolled, and gradually a very strong and efficient service was built up. Later a close co-operation was established with the American Army and Naval Air Services, in which ideas, equipment, materials and methods were interchanged.

The provision of photographs of the areas controlled by the enemy required the use of special aircraft, able to fly deep into enemy country at a height and speed which rendered their interception difficult. This meant the production of special types of our fastest machines, and the training of special pilots to navigate and fly them. The aircraft were generally fitted with two or more cameras, so that the maximum number of useful photographs could be obtained on every sortie. Cameras of the type in service at the outbreak of war were very largely employed, but lens makers were called upon to produce new types of lenses of long focal length for use in them. The general features of these cameras had been designed at the close of the War of 1914–18; they have automatic operation with distant control, and a magazine of film for 250 exposures. As the result of constant research and experiment, many important improvements in the design have been introduced. Later a new type, with a magazine holding 500 exposures, was brought into service, and a somewhat similar instrument designed by the Fairchild Co. in the United States was also used.

The cameras were generally mounted in the aircraft with the optical axis vertical, or slightly tilted so that by the simultaneous use of two instruments greater lateral cover could be obtained. For low-level photographs cameras were installed in an oblique position in the fuselage or under the wings; very valuable work was done with two synchronized cameras facing forwards and giving stereoscopic results. The task of obtaining pictures of specific installations from a low altitude made great demands on the skill and daring of the pilots; it was generally attended by considerable risks.

The operation of cameras at high altitudes produced some special problems, such as the effects of the intense cold on the moving parts, and the occurrence of condensation on the lenses. Special heating arrangements had to be devised to ensure the efficient operation of the cameras at very low temperatures. At low altitudes difficulties were introduced by the very rapid movement of the aircraft. These were solved by the design of new cameras with a moving film. Specially modified types were also needed to secure at night photographs taken by the light of a powerful magnesium flash, or depicting the incendiary bombs dropped by bomber forces and the fires they started.

Photographic chemists have played an important part by producing sensitized films suitable for the work which had to be done, and by devising methods for processing exposed film so that a negative with a very fine grain could be produced in a minimum period of time. In view of all the operating conditions, panchromatic material proved to be the most useful, but infra-red film was sometimes used, and colour film has been recently employed for special tasks.

The production of air photographs whenever the weather was favourable, in sufficient numbers to give a picture of enemies' resources, activities and defences, and to provide the topographical information required by the planning staff, is only one part of the work of photographic intelligence in war. The other part is the detailed examination of the prints and the production of reports on what has been observed. This is often a lengthy and somewhat laborious process. In addition, some of the material may be employed in map revision, or may be used for the construction of models to show the appearance of an area as seen from sea-level or from a low altitude.

For all these purposes pairs of prints are studied with a stereoscope, which gives the observer some measure of appreciation of the relief of the terrain and of the height of objects. Whenever possible, the latest photographs are carefully compared with pictures of the same area taken at an earlier date. This work requires well-trained observers with a good visual memory; they must be able to appreciate the significance of small details, of shadows cast by objects and of changes which may have occurred after a lapse of time. It is often necessary to measure quickly and accurately the sizes of small features seen on the photographs, and from this to determine their actual size. They must be familiar with the appearance and distinctive features of all objects likely to occur on the ground, for reports will not be of full value unless the things that are noticed can be identified. The task of the photographic intelligence officer is thus one of interpretation, and is essentially morphological in character. A very considerable number of men and women who before the War were engaged in scientific research have used their skill and training in this work. Among them were archæologists, geologists, geographers, botanists and zoologists, with some engineers and surveyors; science teachers, artists and many others with suitable intellectual equipment also did valuable work.

Without attempting any complete account of the information gained, some of the subjects investigated may be mentioned. During 1940, after the fall of Dunkirk, the collection of invasion barges in the Channel ports, the movement of enemy shipping, the building of U-boat bases and the construction of airfields in France and the Low Countries were watched. In that year the first air survey of the Ruhr was made; the systematic study of its industrial installations, of oil plants and of the facilities for storing fuel oils in enemy-occupied countries was commenced. At the same period, the results of British bombing attacks on Europe began to be assessed by reference to photographs of targets taken before and after attacks. This work became a task of great importance as the European war proceeded; it served not only as objective evidence of the results of day and night bombing, but it also provided a measure of the efficiency of different types of bombs and of their effect on structures of different kinds.

Suitable annotated photographs of target areas were needed by bombers using the 'H2S' radar equipment. After the Germans had attacked the U.S.S.R., and their armies in Western Europe assumed a defensive role, regular photographic reconnaissance was needed to follow the building of coastal defences. It became possible to give a full report at any time of the state of the enemy's positions along the coast from Holland to the Spanish frontier. Much of this information was used in the planning of commando raids. Detailed study was also given to the building of radar stations by the Germans after the initial discovery of their first station from photographs taken in November 1940. This work required the most careful examination of thousands of photographs and a minute study of all suspicious objects. When a new station had been located on high-altitude pictures, pilots were often able, with great daring, to obtain oblique views from a low altitude which would show the external details of the installation.

As time passed and plans began to be formulated for landing the Allied armies in North Africa, Italy and Normandy, the demands for military information of every kind became enormous. Not only was it necessary to determine the positions and types of the enemy defences and his strength in armoured fighting vehicles, but also to obtain exact information about the characters and gradients of beaches, the nature of the adjoining terrain, of the woods and thickets, the roads, rivers and bridges, and about many other things which might affect the success of a landing. Photographs and the models made from them played a very important part in the preparations for every great offensive action.

Photographic intelligence also played a noteworthy part in naval operations. It was of great assistance in showing the positions of German naval units throughout the War. The location of the battleship *Bismarck* in a Norwegian fjord in 1941 and the subsequent events will be remembered. After long and careful study it became possible to identify in photographs each of the merchant ships used by the enemy and to follow their movements from port to port. Shipbuilding and submarine construction were kept under regular observation and the knowledge obtained assisted the defence of our merchant navy. The method of calculating the speed of a ship, by the study of the waves seen when it was photographed at sea, is an interesting example of research carried out by interpreters with a physical and mathematical background; it had important operational results.

As the years of war passed, some of the research groups of intelligence officers were confronted by problems of considerable difficulty. They had to report on objects which did not exist before the War, and the real nature of which could only be inferred from their appearance. The description and identification of such things required careful observation and scientific reasoning. The radar stations already mentioned were of this class; another example was decoy installations built in Germany with the object of drawing off the attacks of Allied bombers from specific targets. Many of these decoys of different forms were located and described after a long period of study.

A subject which occupied the attention of a small group of specialists was the production of synthetic petrol and other oil. A considerable number of new plants were built after the War had commenced, while the older ones were enlarged or extended. The first problem was to locate the new plants, and after this had been done they had to be studied to discover the processes used and their probable designed capacity. The estimation of the oil resources of the enemy during the later years of the War depended very largely on the reports of this group, which had also to ascertain the effects of bomb damage on production, and to forecast the time which would be taken in the repair of damage. It has been lately learned that the Allied attacks on oil contributed largely to the collapse of the enemy, and these attacks depended to a very large extent on photographic intelligence. The production of synthetic rubber in Germany presented a somewhat similar but still more difficult problem.

It is interesting to notice that photographic reconnaissance showed that a most extensive exploitation of the brown coal deposits of Central Europe had been made for the production of electric power, tar and fuel of different kinds. Very few people in Britain seem to realize the importance of brown coal in the economic life of Germany.

Aircraft construction must be mentioned among the industries which received special study. The appearance of new types was often first announced after the examination of photographs; the development of the jet-propelled Me.262 was recognized in this way.

Of all the tasks carried out by pilots and interpreters of Allied photographic units none was more exacting or more vital than the investigation of the enemy rockets and flying bombs. During the summer of 1943, photographs provided objective evidence of these weapons and showed the places where they were being developed. The successful attack on Peenemunde which followed these discoveries caused a postponement by several months of the launching of the missiles against England. Afterwards, the location of a large number of firing sites in northern France was successfully accomplished, and the accurate bombing of these military installations still further delayed their employment. The enemy then proceeded to construct firing points of a new type which was less obvious from the air, but it was not very long before more than a hundred of these were located. When firing eventually commenced, Allied bombers were able to reduce considerably the projected weight of attack. Attention was also paid to the places where the missiles were manufactured and stored. In the course of the fight against the 'V' weapons, considerably more than a million photographs were taken and examined.

In the Mediterranean area and the Far East, air photography has played an important part to which no reference can yet be made. The production of modern military maps, a most vital service in the warfare of to-day, needs a separate article to show what has been done. Air survey has provided much material for this work; the photographs have been used in different ways, sometimes after the methods worked out by the British Air Survey Committee, sometimes by the rapid methods practised in Canada before the War, sometimes with the help of the Wild Autograph or by the Zeiss Multiplex method.

From all this co-ordinated effort, there should be some legacy capable of useful employment in a world at peace and for scientific work. A vast library of photographs of Western Europe and of other areas now exists in which are numbers of photographs of interest to scientific workers. It is to be hoped that these will be made available for study, and that they will not be destroyed as after the War of 1914–18. Once again we have seen the great value of the air method of determining in great detail the positions of objects on the ground. The use of this method would make possible the study of physical features, of the distribution of vegetation, of the location of antiquities, and many other things which cannot be investigated by ground survey because of the vast labour involved. Attention has already been directed in *Nature* of July 7, p. 2, to the scientific advances which may well result from the continuation of air survey by the R.A.F. in time of peace, and the matter needs careful consideration by the appropriate authorities. The history of air photography in Britain shows how the Fighting Services may suffer if organized units of the R.A.F. are not maintained for this work in the future. But efficiency can only be kept up when there is important work to be done, and Service personnel know that when they carry out good work it will lead to results of permanent value.

The work steadily pursued in Canada between the two Wars should be more widely known. It provides an example of the beneficial results of air survey for civil purposes, while affording experience of the greatest value in case of war. Great areas have been mapped by the Dominion air surveyors, and it may be recalled that so early as 1924 the Forestry Department sent photographs, which were shown at the Empire Exhibition at Wembley, illustrating the practical value to foresters of this work.

Scientific workers have always stood for the value of research even though its immediate practical value cannot be demonstrated, and the same view may be taken of air survey. Only those actively engaged in the detailed geological investigation of the upland areas of Britain know how this work is restricted by the lack of detailed topographical maps. Air photographs would easily remedy this deficiency. In the same way the problems of changes in coastal lands, the study of land utilization as well as town and country planning, could receive immediate help from an organized national photographic reconnaissance unit the results of which were kept in a library similar to the Canadian National Library of Air Photographs (now known as the National Topographical Library, of the Department of Mines and Resources) at Ottawa.

In 1939 few people, either in the Services or in civil life, realized the potentialities of air photography or the part it was destined to play in the great European struggle. The brief account which has been given above should remind us that it may in the same way prove to be of unforeseen value in times of peace.

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[1] For references, see Hart, "Air Photography Applied to Surveying" (1940).

[2] Thomas, H. H., *Nature*, 105, 457 (1920).

SEX EDUCATION: AIMS, POSSIBILITIES AND PLANS*

By CYRIL BIBBY

IT is sometimes forgotten by many educationists to-day how much is owed to the pioneers in the field of sex education. Whatever differences of opinion there may be about the desirability of the specific measures they recommended, it is clear that the great advance in sex education which is taking place to-day could not have occurred if they had not prepared the ground. As a result of their work, views that were novel and unorthodox are now almost commonplace and acceptable even in official circles.

Perhaps the greatest turning point on this path towards official recognition was the transference in 1942 of the major part of the work of the British Social Hygiene Council to the Central Council for Health Education. What this official support has meant to the cause of sex education is perhaps best illustrated by some figures. The numbers of sex education lectures given by these two bodies to certain types of audience during the past five years are as follows:

AUDIENCE	1940–41	1941–42	1942–43	1943–44	1944–45
Teachers	7	95	83	86	232
Youth leaders	17	35	33	59	118
Parents	21	39	37	75	117
Young people	257	612	580	1,348	1,416
School children	71	87	101	208	159

The total attendance at these meetings during 1943–44 was 68,712 (the figures for 1944–45 being not yet available) while, if the audiences at meetings and film shows on venereal diseases are included, the total attendance during the year was some 300,000. Quantitatively, then, the present position is fairly satisfactory. The number of people who have received *some sort* of sex education during the last five years is considerable.

It is clear that there has been of recent years a radical and widespread change of public opinion on the question of sex education. The time has passed when it was necessary to state with some vehemence the case against sheer obscurantism. Probably there will remain with us for many years a few frightened adults who will continue to foster the cult of ignorance; but an increasingly large section of the population is allowing the myths of the gooseberry bush and the stork to fade into oblivion. The general public, educational and medical administrators, churches and social organizations, teachers and youth leaders, parents and pupils—all are ready to go ahead. No longer is it necessary to press the claims of sex education in language more vigorous than profound. Now is the need for careful study of the many educational issues involved. Only after such study is it likely that the position in sex education will be at all satisfactory as regards quality.

The first issue for study is that of objective. What are the aims of sex education and what are its possibilities? To serve as a basis for useful action, an objective must be desirable, attainable and sufficient—and this cannot be said of some aims that have been propounded.

There are, for example, those who use 'sex education' as an euphemism for dilation on the horrors of venereal disease, and hope to frighten young people into 'goodness'. But sex education is not mere anti-venereal propaganda; it is preparation to live a joyous, well-balanced and fruitful life. There are others whose aim is to produce 'morality' by threats of fire and brimstone. But the educationist can have no concern with such 'goodness' and such 'morality'. Such aims fail on the test of desirability.

Other aims, perhaps desirable enough in themselves, fail on the score of feasibility. To expect by sex education alone to wipe out prostitution and casual promiscuity, to make all marriages successful and all divorces disappear, to abolish adultery and prevent all fornication, is to be hopelessly unrealistic. Many and deep seated are the sexual ills of society, and education unaided will not eradicate them. Economic and political changes and a new social and spiritual vision are needed too.

Now what of the criterion of sufficiency? A great many people seem to imagine that sex education consists merely of imparting the so-called 'facts of life', although one would have thought that the inadequacy of this conception were sufficiently clear. A study of ancient or contemporary history, or even a superficial knowledge of the lives of one's acquaintances, will rapidly dispel any illusion that there is necessarily a close correlation between the extent of an individual's biological knowledge and the excellence of his actions.

The teaching of the obvious biological facts will make it clear to our children that the human sex organs are essentially similar to those of other mammals, such as the rabbit; and if sex education were to stop there, it would be logical for a child to deduce that the sexual behaviour of a healthy young human should not be very different from that of a healthy young rabbit. But since presumably we do not wish to adopt the rabbit as the model for our sexual behaviour, sex education must at the appropriate stages deal also with those respects in which humans *differ* from the other mammals, and in particular with the consequences of the unique development of our nervous system and of our peculiar sociability.

But still something else is needed. Our children must be inspired with a feeling of the excellence of sex and of its immense potentialities. Our young people, if they are to deny themselves the immediate sensual pleasures with which our bodies can so richly provide us, must see some reason for such a sacrifice. If they are to be asked to wait, they must feel that they have a future, and a future that is worth waiting for. If society is to make demands, it must see to it that its members think sufficiently highly of it to be willing to accede to them. Behaviour is dependent upon ideals and inspiration, as well as upon factual knowledge and intellectual understanding.

It is, however, easy enough to criticize aims expounded or implied by others. Much more difficult is the task of formulating a statement to take their place. I do not feel sufficiently confident to do so at all dogmatically; but at any rate a tentative effort should be made. I would, therefore, define the aims of sex education something along these lines: "That our people should grow up learning the appropriate facts in the best possible way; that their general attitude to sex should be a completely healthy one; that they should draw up for themselves a code of conduct after careful consideration of all the issues involved and should endeavour to behave according to this rationally determined code; and that they should react to the behaviour of others with sympathy, tolerance and charity, but without spineless acquiescence in a code inferior to their own." No doubt this statement of aims could be much improved, but it will serve as a working basis for the time being.

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* Substance of an address at the annual general meeting of the Eugenics Society on May 29. The paper will be published in full in the *Eugenics Review*.

First, what constitutes 'appropriate' knowledge and at what age should it be imparted ? This latter query is clearly one to which there is no simple answer. No one age can be prescribed for sex education, any more than it can for any other aspect of health education or character training. Sex education should surely be a continuous process from early years to later life, and the question should really be re-phrased to read : What aspects of sex education are particularly appropriate to different ages ? This is obviously difficult to answer in general terms, for no one human is exactly like another; but if we call to our aid that mythical creature the 'average' person, a reply may be attempted.

I would suggest that by about the age of two or three years, children should be learning the polite terminology for the sex organs, just as they learn the words 'arm', 'leg', and 'head'. By the time they go to school at about five, they should in most cases know that the baby grows inside the mother and is born *via* an opening between her legs ; and should understand something of the similarities between birth in humans and in the domestic mammals. During the next two or three years the child should learn that the father contributes the sperm cell which fertilizes the mother's egg, and that the penis is placed in the vagina during mating.

These apparently dogmatic statements about the order in which information should be imparted are not made without reason. The suggested order is that indicated by analysis of the questions typically asked by children of various ages. Questions about birth and pregnancy tend to be asked first of all. It is usually only later that the child inquires about the role of the father, and thus elicits explanations of fertilization and copulation. My belief is that, in general, the right time for enlightenment is when the child seeks it—not when some adult thinks that an appropriate age has been reached.

There are some things, however, in which the adult must act as pacemaker, because the adult knows what sort of ground lies ahead and the child does not. Some time from about the age of twelve onwards a girl will begin her menses, and she needs to be prepared in advance by a simple biological explanation at the age of about eleven. Boys also should have an idea of the significance of menstruation, so that they do not build up on a basis of ignorance an atmosphere of mystery about their sister's periods. But more important for boys is a preparation for the changes that will occur in themselves during adolescence, and in particular for the onset of seminal emissions which, accompanied as they often are by erotic dreams, cause adolescent boys a good deal of needless worry. Minds worried and terrified by the outrageous allegations which still circulate about the alleged ill-effects of masturbation need also to be set at rest—or, better still, so fortified by the truth that the worries and fears never materialize.

So far no mention has been made of any other than the reproductive aspect of sex, and there is, I believe, good reason for this. It is clear from their whole attitude that most children of less than about twelve years (or even older) think of sex as a purely reproductive matter, and have no conception of its amatory aspect. During the three or four succeeding years, however, the endocrine changes of adolescence begin to produce deeper sexual feelings ; an understanding of the love aspect of sex begins to dawn and, with it, an interest in the morals and social conventions of sexual behaviour. This, therefore, I suggest is the period when a point should be made of explaining something more of the influence of the endocrine secretions on the body and the emotions. This, too, is probably the best time for discussing questions such as courtship and marriage, 'necking and petting', promiscuity and prostitution ; and for imparting the elementary facts about the venereal diseases.

Towards the end of adolescence and in early adult life, general sex education merges into specific marriage preparation and guidance—a topic too large to consider in any detail now. It may be suggested, however, that apart from a knowledge of the actual technique of intercourse, sex education during the courtship stage should emphasize the importance of each partner understanding well the emotional peculiarities of the other and exercising delicacy and restraint in whatever degree of love-making may be mutually agreed upon. Couples contemplating marriage should be encouraged to learn something of each other's physical and mental health ; to understand the economic implications of marriage and parenthood ; to reach agreement on how their future home is to be run ; and they should be informed of the sources to which they can turn for further information and guidance.

Sex education, however, should not end with marriage. Apart from any continuing guidance in the technique of intercourse, I believe that all married couples should have some training in child care and parentcraft and—of particular relevance here—should be given some understanding of the normal sexual development of children and of how to cope with the problems arising from it. Here, however, the sex education of one generation merges into that of the next ; and perhaps we had better leave the matter for the time being.

The next problem is that of the encouragement of a healthy attitude to sex, and this is a difficult matter—partly because there is by no means unanimity about what in fact constitutes a healthy attitude. I can do no more, therefore, than register my own personal *credo*.

It seems clear that on impressions gained and attitudes formed in the first five years of life depend to a considerable extent the emotional balance and happiness of the adult. Let us, therefore, examine some of the factors influencing these impressions and attitudes. Because of the close physical proximity and nervous connexion between the voiding and the genital organs, attitudes developed with reference to the former are likely to be transferred to the latter. Any feeling of distaste for the process or the products of voiding may, therefore, have a decidedly unfortunate influence on later feelings about sex. Thus it is patently important not to encourage such feelings ; but on the contrary to convey the impression that voiding, like eating, is a perfectly normal and proper process.

Then there is the question of the so-called 'infantile masturbation'. It is unfortunately the case that many parents, mistaking the exploratory path of innocence for the broad highway of incipient vice, either tell the child not to be 'nasty' or 'rude', or by some action show their disapproval. What is the poor infant to think, that it may safely pull its nose and may twiddle its toes with impunity; but if it does the same in a region half-way between, it incurs displeasure? Clearly there is nothing better calculated to encourage the feeling from the earliest days, that there is something quite isolated from the rest of life, something unclean, about the sexual organs, and hence at a later date by association, about the sexual functions. This too, therefore, must be avoided.

Now, what of the question of nudity? It is a commonplace that attitudes to sex are often associated with similar attitudes towards nudity, so if a child from the first learns to regard nudity as in no way an indecent phenomenon, it is reasonable to hope that it will be helped in the development of a healthy attitude to sex. Naturally, however, children must, to save both themselves and others from embarrassment, learn as they grow up that there are occasions and places, including most public occasions and public places, in which nudity is frowned upon.

A great opportunity for encouraging a proper attitude to sex occurs when another child is expected in the family. By careful preparation on the part of the parents, a sense of pleasurable anticipation may be aroused in the children and crowned with a feeling of family solidarity when the baby arrives, and that surely is the goal to aim at.

During these early years, moreover, there are certain attitudes not specifically sexual in nature which are, nevertheless, of fundamental importance in laying the foundations for a successful family life in later years. I have in mind the development of habitual friendliness to the other members of the family, of affection and consideration for others, of willingness to share possessions and to co-operate amicably in activities with playmates. I have in mind also the growth of interest in, and of a sense of wonder at, the workings of Nature, the growth of an æsthetic sense, of a desire for personal health and cleanliness, of admiration for vigour and smartness, of distaste for furtiveness and dishonesty. Sex education, indeed, interpenetrates indissolubly with general character training.

With the onset of adolescence other more specifically sexual attitudes become important. One should endeavour to arouse a sense of pride in approaching maturity. It is important also that each sex should develop an attitude of sympathetic consideration to the other, regarding friendships as perfectly natural and quite desirable, but as needing the exercise of discretion and restraint. This is the period too, I suggest, when one should particularly endeavour to encourage an attitude of distaste for obscenity and pornography—without, however, going to the other extreme of prudery or priggishness. There are those, I know, who believe that sex is so sacred that it should never be the object of humour. For my part, I *do* feel that certain aspects of sex and sex behaviour are sometimes rather ludicrous, that sex *may* sometimes quite properly be the occasion of humour; and I would therefore emphasize the importance of avoiding the sin of hypocrisy. The distinction to make is surely that between hearty, unashamed laughter and nasty, shamefaced sniggering; between something which is funny and incidentally sexual and something which is merely filthy in nature.

By the time adult life is reached, basic attitudes are already largely determined. It is important, however, if the idea of sex education is to be widened, as I believe it should be, into a conception of education for family life, that we should devote attention to encouraging those contemplating marriage to be willing to discuss reasonably and in a friendly spirit, such matters as the economic running of the home, the division of domestic duties, family planning and so on; and that we should endeavour to ensure that married persons should be considerate in all things towards the spouse, should not regard the wedding ceremony as terminating the period of courtship; should have a proper attitude to the upbringing of their offspring. But once again we have made the circle, and have reached to the next generation.

(*To be continued.*)

OBITUARIES

Mr. W. Sydney Smith, C.B., O.B.E.

William Sydney Smith was a native of Nottingham. He was born in 1866, the eldest son of Samuel Smith, of the firm of Sydney Smith and Sons, engineers. Educated at Nottingham High School, where he excelled in class and in sports, at the age of sixteen he was apprenticed to a Nottingham engineering firm. During his apprenticeship, while working from 6 a.m. to 5.30 p.m., he attended evening classes, an early indication of his grit and determination. He first intended to take up teaching, but winning in 1889 a Whitworth Exhibition of £100, he decided to follow the family tradition of engineering, and taking his B.Sc. (London) degree, in 1890, he joined his father in his engineering business for a short time. He then went to an electrical engineering firm at Westminster, and on, for a while, to Willans and Robinson at Thames Ditton, returning to his father's firm in 1893.

On the death of his father in 1895, Sydney Smith sat for a Home Office examination and was appointed one of H.M. inspectors of factories, going to Manchester in 1896 and from there in 1905 to Derby. While in Manchester he compiled a 'blue book' on hoists and lifts. In 1908 he was appointed H.M. inspector of dangerous trades at the Home Office.

Early in 1918 the late Sir Henry Fowler, who had known Sydney Smith at Derby and had a high opinion of his personal qualities and his engineering ability, recommended him as his successor as chief superintendent of the Royal Aircraft Establishment at Farnborough, Hants, and he served there until his retirement in 1928.

Though having little aeronautical experience, Sydney Smith quickly grasped the essentials of the work of the Establishment, and he keenly encouraged all steps to improve its effectiveness as the main centre of aeronautical research, and to make its resources, and the results of its work, readily available to the aircraft industry. The period of his work at the Royal Aircraft Establishment was not an easy one; after the change from a war economy to that of peace, the further retrenchment in Government expenditure necessitated the discharge of a large number of the employees. He was a great friend of the staff and workpeople, to whom he was endeared by his obvious integrity, his strict fairness to all and his sympathy and consideration for their welfare; and it was very painful to him to have to discharge men at a time when employment was not easy to obtain.

His work at the Royal Aircraft Establishment was recognized by the award of the O.B.E. in 1918 and C.B. in 1922.

Sydney Smith had a great habit of early rising, and usually spent an hour or two before breakfast working in his garden, which was his chief relaxation. He was an ardent supporter of improvement in educational facilities both for the trade lads within the Establishment and in the provision of a junior technical school and evening classes and a secondary school in the district.

His garden and his local activities (among other things he was a member and vice-chairman of the Surrey N.W. Area Assessment Committee) gave him satisfying occupation during his retirement, until his strength gradually failed and he died at his home, "The Pines", Camberley, on July 15, 1945.

He married in 1907, Hilda Mary, the daughter of William Charles Tuke, of Manchester, who, with three daughters, survives him.

WE regret to announce the following deaths:

Miss Lucy Ashcroft, formerly lecturer in mathematics in the University of Reading, on September 30.

Prof. A. E. Edgecombe, associate professor of botany in Northwestern University, Evanston, Illinois, known for his work in mycology, on March 30, aged forty-eight.

Peter Esben-Petersen, a Danish authority on the systematics of neuropterous insects, on April 2, 1942.

Prof. E. Shearer, formerly professor of agriculture and rural economy in the University of Edinburgh and sometime director-general of the Ministry of Agriculture, Egypt, on September 14.

Prof. E. J. Williams, F.R.S., professor of physics in the University College of Wales, Aberystwyth, on September 29, aged forty-two.

NEWS and VIEWS

Prof. Norman Feather, F.R.S.

DR. NORMAN FEATHER takes up his appointment as professor of natural philosophy in the University of Edinburgh this session. Dr. Feather has held the appointment of lecturer in physics in the University of Cambridge since 1936; he was elected to a research fellowship of Trinity College in 1929, and to a staff fellowship in 1936. After taking the Natural Sciences Tripos in Cambridge, Dr. Feather took up research work under Lord Rutherford in 1927 and worked first on the long-range α-particles from radium. He spent a year at Johns Hopkins University in Baltimore, and there studied the relations between β-particle energies and absorption coefficients, deducing therefrom a much used empirical relation. Returning to Cambridge in 1930, he resumed work with the Wilson cloud chamber, and in 1932 was brought in by Dr. J. (now Sir James) Chadwick to obtain cloud chamber confirmation of his discovery of the neutron. Within a few weeks, Dr. Feather was able to obtain tracks resulting from neutron collisions and, in particular, was able to demonstrate the disintegration of nitrogen by neutrons. This was the first evidence of disintegrations produced by neutrons.

In 1935 Dr. Feather joined Prof. Chadwick, who had in the meantime been appointed to the chair of physics in the University of Liverpool, and for two years helped to build up the physics research facilities there. During this period, Prof. Chadwick and he studied the photo-disintegration of deuterium. He returned to Cambridge as lecturer in physics and staff fellow of Trinity College. He then took up the study of nuclear energy-levels by the coincidence methods of counting which have since borne good fruit. Dr. Feather is the author of a biography of Lord Rutherford and a treatise on radioactivity. In the early days of the War, along with the rest of the Cavendish Laboratory staff, he headed a party manning a south-east coast radar station. He returned from there to shoulder a major share of the teaching and administrative duties of the Cavendish Laboratory and, early in 1940, under the sponsorship of the M.A.U.D. Committee of the Ministry of Aircraft Production, took up work with Bretscher on the measurement of nuclear cross-sections required to establish the feasibility and size of an atomic bomb. He has since been a member of the British technical committee which has directed the work of the British group concerned with atomic energy.

Anatomy at University College, London
Appointment of Mr. J. Z. Young, F.R.S.

THE appointment of Mr. J. Z. Young, demonstrator in zoology in the University of Oxford, to the chair of anatomy at University College, London, provides an interesting departure from the normal practice in Great Britain in filling chairs of anatomy. Tradition in this Department at University College, deriving largely from Elliot Smith's wide range of activities, favours a broad conception of the field of anatomy which is thus likely to be continued. Prof. Young's work before the War on the nervous system of many species and his fruitful collaboration with clinical colleagues on the Nerve Injuries Committee of the Medical Research Council during the War suggests, further, that the especial emphasis on neurological anatomy associated with the work of Elliot Smith and Woollard at University College, London, is to be maintained. Experience gleaned in unusual fields should enable Prof. Young to bring fresh and arresting ideas to the current reconsideration of preclinical training, and new developments in the teaching of anatomy may confidently be anticipated.

Prof. R. P. Linstead, F.R.S.

PROF. R. P. LINSTEAD, whose appointment as director of the Chemical Research Laboratory, Teddington, has just been announced, was educated at the City of London School and at the Imperial College of Science and Technology, where he had a brilliant career. He graduated in 1924 and entered J. F. Thorpe's flourishing school of organic chemistry, working with G. A. R. Kon on three-carbon tautomerism. After obtaining the degree of Ph.D. in 1926, he succeeded Kon as private assistant to Thorpe, a post which enabled him to devote all his energies to research. During this period he worked out a method for the estimation of isomeric unsaturated compounds in mixtures, which enabled considerable progress to be made in the study of unsaturation and of tautomerism of unsaturated compounds. He obtained the degree of D.Sc. in 1930. Linstead spent a year away from academic work with the Anglo-Iranian Oil Co., then returned to the Imperial College as a member of the staff and remained there until 1938, when he accepted the Firth chair of chemistry at the University of Sheffield. He moved to Harvard in the following year, but was soon afterwards seconded for service with the Ministry of Supply, where he acted as deputy director of scientific research.

Prof. Linstead's scientific work is characterized by remarkable thoroughness and breadth of view; he is clearly not interested in quick returns and likes to tackle problems of fundamental significance. His best-known contributions include studies of unsaturated acids, carbocyclic fused-ring compounds and the discovery of a very interesting new class of synthetic pigments, the phthalocyanines; his recent investigation on the stereochemistry of catalytic hydrogenation is a particularly finished piece of work. Prof. Linstead, who is forty-three, was elected a fellow of the Royal Society in 1940 and is an honorary M.A. of Harvard University.

Wellcome Museum of Medical Science: Appointments

WING-COMMANDER C. J. HACKETT has been appointed director of the Wellcome Museum of Medical Science in succession to Dr. S. H. Daukes, who has been responsible for the development of this Museum during the last twenty-six years. Dr. Hackett, who was a research fellow in tropical medicine of the Medical Research Council and who has done important work on yaws and other tropical diseases, will take up his new appointment as soon as he has been released from the Royal Air Force.

Dr. E. Ashworth Underwood has been appointed director of the Wellcome Historical Medical Museum and the Wellcome Historical Medical Library, and will take up his new duties as soon as he can be released from his present post of medical officer of health and chief school medical officer of the County Borough of West Ham. Dr. Underwood has held his present post for the past eight years. Before that he was medical officer of health of the Metropolitan Borough of Shoreditch, deputy medical officer of health of the city of Leeds, and lecturer in public health in the University of Leeds. In this field he has written widely on tuberculosis, on epidemiology and allied subjects. Dr. Underwood is well known for his activities in the sphere of the history of medicine. During the past five years he has been honorary secretary of the History of Medicine Section of the Royal Society of Medicine. He has contributed to the *Proceedings* of that Society, and to other journals, studies on the history of certain infectious diseases, on the medical importance of Lavoisier and the French chemists, on the earlier anatomists and on other subjects. He has for some time been collaborating with Prof. Charles Singer in work on Vesalius.

National Research Council (Canada)

THREE new members have been appointed to the National Research Council (Canada) and two other members have been reappointed. The new members are: Mr. Percy Bengough, president, Trades and Labour Congress of Canada, Ottawa; Dr. Paul Gagnon, director, Department of Chemical Engineering, Laval University, Quebec; and Prof. David A. Keys, Macdonald professor of physics and chairman of the Physical Sciences Group of the Faculty of Arts and Science, McGill University, Montreal. The two members reappointed are Prof. J. A. Gray, Chown science research professor, Queen's University, Kingston, Ontario, and Mr. Arthur Surveyer, consulting engineer, Montreal, Quebec.

Scientific Co-operation with Czechoslovakia

SIR ALFRED EGERTON, one of the secretaries of the Royal Society of London, has left for a visit to Prague to convey the greetings of the Royal Society on behalf of the men of science of Great Britain to their colleagues in Czechoslovakia. He will be the guest of the rector of the Charles University in Prague and will discuss with him and his colleagues what aid British science can give to the rehabilitation of science and scientific education in their country. It is hoped that this visit may do much to enable the people of Czechoslovakia to re-establish firm scientific contacts with men of science throughout the world. Sir Alfred Egerton is taking with him, for the Masaryk University at Brno and the Royal Bohemian Society of Sciences at Prague, scientific publications of the Royal Society issued during the war years.

Czech Botanists During the War

BOTANICAL research, like that in other branches of science, almost ceased in Central Europe when the Germans marched in. With their laboratories closed, Czech botanists retreated to their gardens and homes, where they had the leisure in which to examine the results of previous researches, conducted before such work was interrupted. Prof. Bohumil Němec, already the author of several standard Czech botanical works, wrote a comprehensive treatise on "Plant Life", in which he used more than seven hundred original illustrations. In addition, he published a more popular work, "The Green Kingdom", and also articles dealing with the mechanism of plant growth, movement and reproduction for biological and scientific journals, which seem to have increased in importance as the nation's position became more desperate. Dr. S. Prát continued to publish sections of his "Rostlinopis", a kind of botanical encyclopædia inspired, apparently, by the work a hundred years ago of those two pioneers of botany in Bohemia, the brothers J. S. and K. B. Presl, who used the same title for their "Botany", which they did not live to complete.

In mycology, Dr. J. Peklo published several long papers (including a seventy-page monograph) on the genetics of certain fungi and the problem of 'relative sexuality' among lower plants. As these contributions to botany are written in Czech they will not receive much attention until detailed abstracts are available in English. Not all Czech botanists were fortunate enough to remain unmolested. Prof. Němec's son was obliged to hide in the forests of Slovakia, and the exposure has impaired his health. Dr. Augustus Bayer, professor of botany in the Masaryk University of Brno, was executed by the Germans in 1942. He was a specialist on the development and anatomy of wood tissues. Dr. Bayer, who was sixty years of age, had also been engaged upon problems in forestry and agriculture, and indeed had gained an international reputation as an expert in applied botany and dendrology.

Jubilee of the Newcomen Society

THE next meeting of the Newcomen Society, to be held on November 14, will mark the completion of twenty-five years activity of the Society. The officers of the Society in 1920 included A. Titley as president, three vice-presidents, ten members of council and H. W. Dickinson as honorary secretary and treasurer; of these fifteen members, seven have served on the Council during the whole twenty-five years, Dr.

Dickinson serving as sole or joint honorary secretary for the whole period except for the two years of his presidency 1932–34, when A. Stowers took office. The growth of the Society can be traced in successive annual reports published in the *Transactions*. The first volume of *Transactions*—that published in 1922—occupied 83 pages, and contained six papers and a list of 120 members; volume 20, 1939–40 (the last before the War), exceeded 180 pages and contained twenty papers, while the annual report gave the membership as 1,512. Since then the membership has risen to more than 5,000, principally due to the activities of the American members. Besides the papers, the *Transactions* have contained a valuable analytical bibliography of the history of engineering and applied science. The Newcomen Society owes much to Dr. Dickinson for his long service as secretary, and also for his editorship of nearly every volume of the *Transactions*. It has, therefore, been decided to invite subscriptions to a Dr. Dickinson Presentation Fund, the proceeds from which will be given to Dr. Dickinson in the form of a cheque or be expended on objects chosen by him. The upper limit for subscriptions is fixed at £2 2*s*. Members wishing to subscribe are asked to send their subscriptions, not later than October 10, to the assistant secretary, Miss G. Bingham, O.B.E., 43 King's Road, Chelsea, S.W.3, made payable to the "Dr. Dickinson Presentation Fund". Dr. Dickinson will be entertained to dinner after the annual general meeting on November 14, when the presentation will be made.

University and Research Libraries

The University and Research Section of the Library Association held its first week-end conference since 1938 on September 21–24 at Wadham College, Oxford. The Conference was well attended, and visits were paid to many of the Oxford college and other libraries. The general meeting of the Section held on September 22 and 23 was concerned chiefly with the discussion, amendment and final approval of the Committee's proposals for the post-war development of university and research libraries. As soon as they are approved by the Library Association Council, they will be issued to the general public. Reference has already been made in *Nature* (Dec. 11, 1943, p. 687; February 19, 1944, p. 203) to these proposals which are intended to ensure an adequate supply of books and other materials for the prosecution of research in Britain. They deal with the place of university and research libraries in a national system, the national and local organization for research, administration and staffing, and plead for the fullest co-ordination of all library facilities. But this cannot be achieved until the national library resources have been comprehensively and qualitatively surveyed, a long overdue piece of bibliographical research. The programme of such a survey has been prepared by a committee of the Section's and it is hoped that funds will eventually be forthcoming for the project.

M. Henri Lemaître, a vice-president of the Library Association and formerly librarian of the Bibliothèque Nationale, was unable to attend through illness to deliver his promised address. Fortunately, a copy had arrived, and was translated and read to the session. M. Lemaître outlined the story of French libraries and librarians during the German occupation, a record of destruction and racial discrimination. During 1940–45, more than two million books were lost through the ravages of war, many of them forming the irreplaceable local collections in which France abounded. Many thousands of books, including complete libraries, were seized by the Germans. Yet French librarians stood firm against all threats, and continued to serve their readers to the best of their ability. In their private lives and in their professional occupation they were in the van of the struggle against the Nazis, and many suffered imprisonment and death for their devotion. Despite Nazi opposition they maintained a supply of books to French prisoners of war. They continued to supply books on the various proscribed lists to trustworthy readers; and when liberation came, they were ready with their plans for rehabilitation with the creation of new book centres for the French people on the lines of the English county library system.

Grants for Dental Teaching and Research

The Nuffield Foundation has agreed to make grants for the promotion of dental teaching and research in Great Britain. The assistance provided by the Foundation is to be in three parts. First, grants totalling £9,000 a year for ten years are to be made to the Sutherland Dental School, University of Durham; University of Leeds Dental School; the Turner Dental School, University of Manchester; and Guy's Hospital Dental School, for the development of research work on preventive dentistry. Secondly, Nuffield dental fellowships will be established to improve the supply of dental research workers and teachers. Lastly, a few scholarships to enable dental students of outstanding ability to receive a more thorough scientific training will be awarded. Fellowships will be open to three groups of candidates: those with dental qualifications, university graduates in medicine, and thirdly those holding a university science degree; the annual value will be between £400 and £800. Scholarships, providing tuition fees and a subsistence allowance not exceeding £200 a year, are intended for candidates who, in the opinion of their dental school, would profit by receiving, during their course of training, additional instruction in anatomy and physiology. Forms of application for fellowships and studentships may be obtained from the Secretary of the Nuffield Foundation, 12–13 Mecklenburgh Square, London, W.C.1.

Announcements

Mr. Archibald N. Black has been appointed Donald Pollock reader in engineering science in the University of Oxford.

Dr. J. E. Hurst, technical director of Bradley and Foster, Ltd., Bradleys Concrete, Ltd., of Darlaston, and director of research of the Staveley-Bradley, Foster Research Laboratory Institute at Sheepbridge, is to be Sheriff of the City and County of Lichfield. Dr. Hurst is president of the Staffordshire Iron and Steel Institute, and is known for his work on the heat treatment of cast-iron and the development of cast-iron suitable for nitrogen hardening.

The Stephen Paget Memorial Lecture of the Research Defence Society is being resumed this year and will be given by Sir William Savage on the occasion of the annual general meeting of the Society, the title being "Public Health and its Debt to Experimental Medical Research". The meeting will be held at Manson House, Royal Society of Tropical Medicine and Hygiene, London, on October 12.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Anti-*Hr* Sera

THIS communication is sent in order to acknowledge an error which has misled Race, McFarlane, Cappell[1] and Fisher[2] in their communications in *Nature* of May 5, 1945, entitled "Anti-*Hr* serum of Levine". At the same time, I take the occasion to make a few additional comments on some of the problems in this new field of research, so important for the clinician as well as the theoretical investigator.

In their discussion on the relationship of the anti-*Hr* and their *St* serum, the British workers conclude that these sera are not identical. On purely hypothetical considerations, Fisher had previously assumed the existence of at least three different varieties of anti-*Hr* sera, named by him, γ, δ and η. Until recently, the only anti-*Hr* sera described corresponded to the variety γ, which gives about 80 per cent positive reactions among white individuals. A serum of the type η characterized by an incidence of 96 per cent reactions was recently studied by Mourant[3].

Race and Fisher now believe that the one of the anti-*Hr* sera of Levine corresponds to the hypothetical antibody δ of Fisher. The only evidence in support of their contention is derived from the following statement made, but not further substantiated, in a paper by Waller and Levine[4]: ". . . in tests with a potent anti-*Hr* serum all the Rh_1Rh_2 bloods gave negative reactions . . .". Unfortunately, this statement does not correctly describe my actual findings, which were hitherto not published but were mentioned incidentally in the paper by Waller and Levine entitled "On the *Rh* and Other Blood Factors in Japanese".

In order to clarify the situation, the results of tests on the blood of 335 white and 135 coloured individuals with potent anti-Rh_0, anti-Rh', anti-Rh'', and anti-*Hr* are summarized below. The error mentioned occurred in the brief reference to these studies carried out during April–July, 1944.

Number tested	White (335)		Coloured (135)	
Type	Incidence	*Hr* positive (%)	Incidence	*Hr* positive (%)
Rh_1Rh_2	14·63	100	4·44	100
Rh_2	16·72	100	16·30	100
Rh_1	49·85	61·7	23 70	96·3
Rh_0	2·69	100	45·93	100
$Rh'Rh''$	0·00		0·00	
Rh''	1·19	100	0·74	100
Rh'	0·87	100	1·48	100
Rh negative	14 03	100	7·41	100
All types		80·9		99·3

Accordingly, the only statement which could be made is that all bloods of the type Rh_1Rh_2 tested are *Hr* positive. I freely admit an error which, although serious, must nevertheless be classified under the category of the clerical variety. It would never have been possible if the data given above had been published in tabular form.

Incidentally, the anti-Rh'' serum employed was derived from an Rh_1 patient immunized by repeated transfusions (titre about 1 : 40). In contrast to Wiener's anti-Rh'' serum, no other agglutinins were present. The anti-*Hr* serum briefly referred to elsewhere[5] had a titre of 1 : 100.

In accordance with Levine's definition of anti-*Hr* specificity, all bloods negative with anti-Rh' (*Rh* negative and Rh_2) give strong reactions with anti-*Hr* sera, while the remaining bloods Rh_1 and Rh' are either negative or give weak reactions[5,6,7]. When the first anti-*Hr* serum, of weak activity, was described in 1941, large quantities of potent human anti-Rh_0 and anti-Rh' sera were already available and distributed by me to several medical centres in the United States. (The first statistical study with these two sera were made by Levine and co-workers in the months of April to June, 1941. At the written request of Dr. Wiener, the incidence of the four subtypes and their reactions with anti-*Hr* serum were made available for the third edition of Dr. Wiener's book[8].) Anti-Rh'' sera were independently described two years later by Race *et al.*[9] and Wiener[10]. As shown by Race, anti-*Hr* agglutinins may now be more rigidly defined also in their relationship to anti-Rh'' serum. Thus, all bloods Rh_1Rh_2, $Rh'Rh''$, and Rh'' react with anti-*Hr* sera of the γ variety.

In the series indicated in the accompanying table, individuals negative for *Hr* were observed in only one type, Rh_1, and these, genetically Rh_1Rh_1, comprise 38·3 per cent of type Rh_1 of the white series. *Hr* negative individuals can be found also in the much smaller group of Rh'.

The incidence of *Hr* positive reactions in the entire white and coloured group were 80·9 and 99·3 per cent respectively. These figures compare well with Wiener's findings of 72 per cent and 98 per cent respectively[11]. As suspected by the latter, his anti-*Hr* serum was not sufficiently active and undoubtedly gave too many negative reactions.

The confusion with regard to the specificity of anti-*Hr* sera is due in part to the practical difficulty in collaboration on the part of British and American workers during the war years. Another factor was my failure to publish more fully on the properties of the potent anti-*Hr* serum referred to briefly in my several papers. A mere statement in the literature that my more potent anti-*Hr* serum gave about 80 per cent positive reactions would have enabled Race and Fisher to detect the clerical error quoted above.

Accordingly, there is no doubt that the *St* and *Hr* sera contain identical antibodies, corresponding to the variety γ of Fisher. This holds true for four sera in the collection of Race, at least two of the three sera observed by Levine, the *Hr* serum of Wiener, Davidsohn and Potter[11], and an extremely potent serum of Vogel. The discovery of η serum by Mourant seems to confirm Fisher's views, but a serum corresponding to the specificity of δ characterized by failure to react with Rh_1Rh_2 is still to be described.

The correlation of the studies by the American and British workers in this complex field is rendered difficult also because of several different terminologies. Another complicating factor is the uncertain supply and the lack of potent reagents essential for genetic investigations based on family and racial studies. This is particularly true for anti-Rh'' and anti-*Hr* sera (γ and η) especially with regard to the existence of several phenotypes of remarkably low incidence[12].

So far as the varying terminologies are concerned, it will undoubtedly become necessary for an international committee of geneticists and serologists to recommend a uniform terminology. Since isoimmunization by the factor *Rh* and its variants is important clinically, one can scarcely expect the clinician to commit to memory, at this stage, several different systems of terminology.

From the point of view of prevention of transfusion accidents and the diagnosis and treatment of erythroblastosis fœtalis, the clinician should concern himself exclusively with the anti-Rh_0 serum, the only one available to hospitals in the United States, and presumably also in Great Britain[13]. I have shown[5] that 92 per cent of all cases of isoimmunization by the *Rh* factor can be detected with this diagnostic reagent. Until a final genetic theory and uniform terminology are agreed upon, it is preferable for the clinician to think in terms of a simple genetic theory based on the behaviour of the standard diagnostic anti-Rh_0 serum which contains but a single antibody. For the exceptional 8 per cent *Rh* positive individuals immunized by variants of the *Rh-Hr* system or other blood factors, the clinician must consult the serological specialist, who may not have on hand potent anti-Rh'' or anti-*Hr* sera.

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Effect of Tissue Extracts in controlling *Staphylococcus aureus* Infections

FOR a number of years our laboratories have been conducting investigations on natural cellular substances, some of which are stimulatory and some inhibitory to growth of tissues and micro-organisms[1,2,3,4]. In connexion with the work on bacteria, we recently reported a substance isolated from both human and ox spleens which, *in vitro*, was germicidal in concentration as low as 1 part in 2,000 for *Streptococcus hæmolyticus*[5]. The present investigations, conducted on *Staphylococcus aureus*, were undertaken as an extension of this work with spleen extract and also include observations on various other ox tissue extracts, primarily brain, heart and kidney.

With extracts of the aforementioned ox organs prepared in a manner similar to that mentioned in a previous report[5], a series of *in vitro* and *in vivo* experiments were conducted on 48-hour cultures of *S. aureus* incubated at 37·5° C. The *in vitro* experiments, incorporating 0·5 and 1·0 per cent of the extracts by weight in the media, indicated that after an initial three-day period of depressed growth, the organism was definitely stimulated, so that at the end of the sixth day colony size and number of the experimentals had increased 2·5 to five times that of the controls. Coincident with this increase in growth, there occurred a decided change in the morphology of the organism, the colony growth being converted from an original orange or yellow *S* variety to a white *R* configuration. Further study also indicated that these organisms varied from the controls in their biochemical characteristics (see table). Except for small percentages of difference in the amount of growth stimulation, these results were the same with all four of the tissue extracts tested.

Tests	Yellow *S* Control organism	White *R* Experimental organism
Fermentation of mannitol	+	−
Liquefaction of gelatin	+	+ (slight)
Chromogenesis	+ (yellow)	− (grey-white)
Hæmolysis	+	−
Coagulase reaction	+	−

Despite the fact that under the influence of the extracts the growth of *S. aureus* had been stimulated, it was felt that the change in biochemical characteristics of the organism following its conversion from the yellow *S* form to the white *R* might have been accompanied by a change in virulence and was therefore of sufficient importance to merit *in vivo* testing. These tests were divided into three separate experimental groups and conducted only with brain extract, since, *in vitro*, this extract had produced the most rapid conversion to the white *R* form. White mice were used in all the experiments, 20 being employed for each experimental group, 10 serving as controls and 10 as experimentals.

First experimental group. In this experiment, conducted for the purpose of determining whether *S. aureus* grown *in vitro* under the influence of brain extract retained its altered characteristics *in vivo*, control mice were infected subcutaneously with 1 c.c. of freshly prepared saline cultures of the yellow *S* organism, while experimentals were infected with a similar amount of the white *R* form. No tissue extract was injected into any of the animals. Three days after infection, control animals developed a gradually ascending paralysis, which resulted in 70 per cent mortality by the fourth day. The remaining 30 per cent developed large abdominal abscesses and sloughs which persisted for three weeks. On the other hand, there was no mortality among the experimental animals. These animals did not develop paralysis, and only 20 per cent developed abdominal lesions of a very minor character which disappeared by the seventh day. Cultures from the lesions in the two groups of animals revealed organisms corresponding to those injected, both as to colour and biochemical characteristics, thus indicating that the white *R* form retains its altered characteristics *in vivo* and as such is less virulent than the yellow *S* form.

Second experimental group. This experiment was conducted as a test of the prophylactic action of brain extract against *S. aureus* infections. Forty-eight hours prior to the subcutaneous inoculation of all animals with 1 c.c. of suspension of yellow *S* organisms, the experimental group was injected subcutaneously with 50 mgm. of brain extract, and thereafter at 24-hour intervals throughout the experiment. Three days after inoculation with staphylococci, all control animals had developed large abdominal abscesses which resulted in 50 per cent mortality. Those animals that lived required three weeks for complete healing. Of the experimental animals, 50 per cent developed no abscesses whatever. The remaining 50 per cent developed very small lesions which were healed in ten days. Total dosage of brain extract for each animal was 500 mgm.

Third experimental group. This experiment was conducted as a test of the therapeutic action of brain extract on *S. aureus* infections. All animals were infected in the manner described for the prophylactic experiment. When the animals developed abdominal lesions on the third day, they were divided into control and experimental groups, and the latter were given daily injections of 50 mgm. of brain extract. As early as two days after the injection of the brain extract, definite improvement was noted in the experimental animals, and by the fourteenth day of the experiment or the eleventh day of treatment all animals were completely healed. There was no mortality. The abscesses in the control group, however, continued to progress and resulted in a final mortality of 60 per cent and a delay in healing of the remaining 40 per cent of three weeks.

Conclusions. A factor has been extracted from ox brain, spleen, heart and kidney tissue, which *in vitro* is capable of converting yellow *S* forms of *S. aureus* to white *R*, the latter having biochemical characteristics quite different from the former. Moreover, this organism retains its altered morphological and biochemical characteristics *in vivo* and is definitely less virulent than the yellow *S* form. Prophylactic and therapeutic tests with the brain extract show that it is effective in preventing and treating *S. aureus* infections, the efficacy of the treatment probably resulting from a decrease in virulence of the organism produced as a result of alteration in its morphological and biochemical characteristics.

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Nov. 8, 1944.

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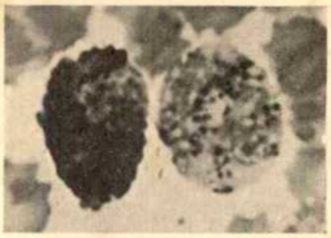
Differentiation between Eosinophils and Pseudo-eosinophils of Rabbits' Blood by means of a Peroxidase Reaction

THE difficulty of distinguishing between eosinophil and pseudo-eosinophil leucocytes in rabbits' blood stained with the usual blood stains is well known. Ehrlich's triglycerin mixture, in which the eosinophil granules are shown up specifically in yellow, gives irregular results and, in general, rather unsatisfactory smears. Recently, I described a new technique for the peroxidase reaction on leucocytes in human blood films employing 2,6-dichlorphenol-indophenol[1]. This technique applied to films of rabbits' blood allows the observer easily to single out the eosinophil leucocytes, even under relatively low power (for example, × 200).

The most suitable procedure is to treat for 5–10 min. fresh, air-dried, formol-alcohol fixed blood films with a mixture of 0·05 per cent aqueous solution of 2,6-dichlorphenol-indophenol (4 pt.) and 0·5 per cent solution of neutral red (1 pt.), to every 5 c.c. of which four drops of hydrogen peroxide (4 vol. per cent) had been added prior to use. After a short wash, the film is blotted dry and oil is directly applied. Under these conditions the cytoplasm of the eosinophil leucocytes is densely packed with heavily stained large spherical granules (up to 1·5 μ in diameter); almost every granule shows a dark purplish-black periphery and a somewhat lighter interior, the colour of which ranges between mauve and a dirty greyish blue, while the pseudo-eosinophil granular leucocytes show much smaller (about 0·5 μ) and scattered dark purplish granules, some of which are more ovoid or rod-shaped than spherical; the granules vary in size, and some, if big enough, also appear as dark rings with a tiny light centre. The contrast between the two types of cells is particularly striking after a short reaction time when only a limited number of granules in each pseudo-eosinophil is stained. If the time is prolonged to 20 min. or more, many more granules in each pseudo-eosinophil become positive This observation is opposed to the view that the enzyme is situated actually on or in the granules.



TWO GRANULAR LEUCOCYTES OF RABBITS' BLOOD; EOSINOPHIL ON THE LEFT. × 1600.

Measurements of cell diameters made with these preparations show the eosinophils to vary from 10 to 12 μ, and the other granular leucocytes from 7 to 10·5 μ. In differential counts the eosinophils are found to represent 1 per cent or less of the white blood corpuscles, which figure agrees well with Klieneberger's data[2]. The relative number of basophils has to be determined by means of one of the usual blood stains.

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Cosmic Radiation Observed at the Col du Lautaret, Hautes-Alpes

LES deux clichés reproduits ici ont été pris dans l'été 1943 au col du Lautaret (2,060 m.) au cours d'une mission organisée par M. Leprince-Ringuet La détente de la chambre de Wilson était commandée par trois compteurs dispersés sur une aire d'une dizaine de m.[2]; deux de ces compteurs étaient couverts de 4 ou de 8 cm. de plomb. Les gerbes des figs 1 et 2 sont donc secondaires de grandes gerbes d'Auger particulièrement riches en rayonnement pénétrant.

La gerbe de la fig. 1 est issue de 14 mm. de laiton Elle est essentiellement constituée de cinq paires serrées régulièrement disposées et faisant entre elles un angle d'environ 1/10 de radian. Les premières deux paires sont visibles sur les images latérales, les trois autres malheureusement pas.

La gerbe comprend une particule lourde (meson ou proton) arrêtée dans l'écran de 15 mm. de plomb Les deux trajectoires de la première paire paraissent donner un secondaire : la première traverse ou donne un secondaire peu dévié (5°) ; la deuxième donne un

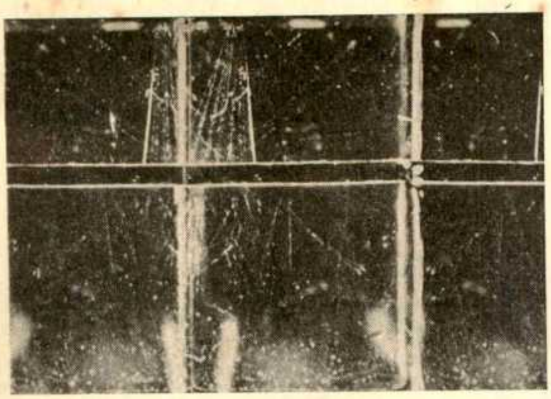

FIG. 1.

secondaire très divergent ou subit une très forte diffusion. Les deuxième et troisième paires sont bloquées. La quatrième paire comprend sans doute en réalité trois trajectoires. L'une d'entre elles est gerbigène et probablement une autre traverse. La cinquième paire donne naissance dans le gaz à un secondaire de grande énergie.

La gerbe de la fig. 2 est créée dans l'écran de 15 mm. de plomb. Elle comprend trois paires faisant un angle de 5° entre elles. Les deux paires latérales sont décomposables à l'observation stéréoscopique. La trajectoire centrale d'ionisation identique ne peut être celle d'une particule lourde lente, un électron de choc de plus de 10 cm. de parcours ne peut avoir été éjecté que par une particule de plus grand v/c que 0·7 et d'ionisation inférieure à 1·5 fois le minimum. Cette trajectoire médiane résulte donc de la superposition de deux trajectoires rapides.

Il existe dans cette série de clichés deux autres gerbes de paires moins typiques et plus discutables.

La diffusion élastique multiple est d'après Euler, Molière, Landau, Bethe, Williams, l'effet prépondérant dans les gerbes cascades. Elle ne peut donner lieu à ces figures régulières et planes. Ces gerbes sont des gerbes de type Heisenberg où plusieurs particules sont créées en un seul acte. Elles paraissent polarisées et semblent impliquer une interaction de spin. La présence d'une particule lourde et probablement d'une ou deux particules pénétrantes semble d'ailleurs suggérer que le champ perturbateur est un champ du type nucléaire comme le prévoit Heisenberg. Elles paraissent associées aux gerbes d'Auger.

Lorsque de telles gerbes se produisent à une profondeur notable dans les écrans, leur régularité géométrique disparaît forcément par absorption, déviation et multiplication des trajectoires.

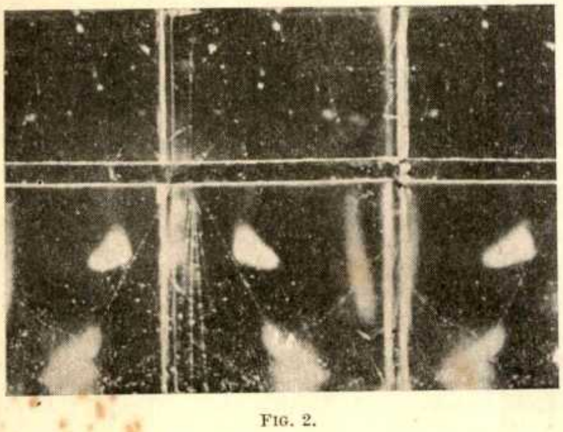

FIG. 2.

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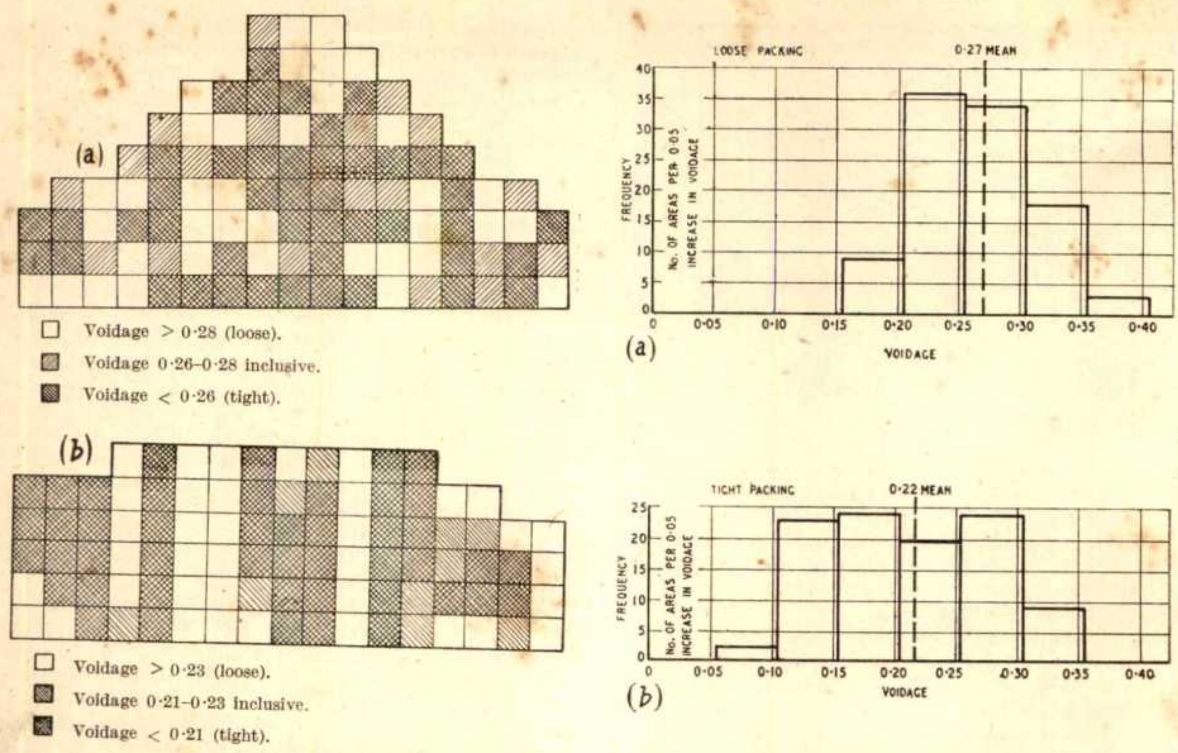
Packing of Regular (Spherical) and Irregular Particles

RECENT correspondence[1,2] in *Nature* cites a theorem on the ordered packing of equal spheres to prove that packings of graded sizes of coal have the same voidage (fraction of free space) for all sizes. This theorem can be stated in its most general form as follows: the overall voidage of any one of the four possible ordered arrangements of equal spheres packed into a container is independent of the relative size of the container provided its size and shape are such that it will contain an integral number of 'unit' cells of the particular ordered arrangement; in all other cases an ordered packing cannot be obtained. Graton and Fraser[3] have given the size and shape of the 'unit' cells for the four arrangements, where one sphere touches six (cubic), eight (orthorhombic), ten (tetragonal) and twelve (rhombohedral) neighbours respectively. The same authors give the correct voidages 0·4764, 0·3954, 0·3019 and 0·2595 for the four cases and discuss also the case of ordered packings of spheres of different sizes. (Mr. Ackermann's figures for the case of eight contacts on each sphere appear to be incorrect.)

This theorem does not apply to the packing of coal for two reasons. First, equal spheres poured into a box take up a disordered arrangement[4], with a voidage between 0·45 and 0·37. Secondly, irregularly shaped particles pack in an entirely different manner. Although the packing is still disordered, the frequency distribution of numbers of contacts are different, particularly for the looser packings. (Compare Smith, Foote and Busang's tests[4] on lead shot, and Bennett and Brown's tests[5] on starch particles.)

It is possible that the observed constant voidage of irregular materials of different sizes is due to two opposing effects. Spiers[6] quotes voidages for packings of graded coal lumps ranging from 0·47 to 0·54 as the size decreases from 1 in. × $\frac{1}{2}$ in. to $\frac{1}{8}$ in. × $\frac{1}{16}$ in. We have found the opposite effect in a small container (10 in. cube); here the voidage decreases from 0·47 to 0·43 for coal sizes from 1 in. × $\frac{1}{2}$ in. to $\frac{1}{4}$ in. × $\frac{1}{8}$ in. Thus an apparent independence of size might be found in practice with certain materials and sizes of containers. Generally, the voidage increases as the relative size of container to particle decreases.

In conclusion we should like to direct attention to Osborne Reynolds' principle of dilatancy[7], which has been overlooked by almost all workers in the field of packing of granular materials. We have shown recently that the principle of dilatancy accounts not only for the non-uniformity in the transmission of forces through granular beds observed and discussed by Jenkin[8], but also for gross non-uniformities in the distribution of local voidage which we have found[9] to be inherent in packed materials (see figures). In practical applications, in fuel beds and coal treatment processes, for example, the non-uniformity of the packing is likely to be of greater significance than any average property such as the overall voidage. For this reason at least, apart from the reasons mentioned above, studies of the geometry of



DISTRIBUTION OF LOCAL VOIDAGE IN LOOSE AND TIGHT TWO-DIMENSIONAL PACKINGS.

Left: Map showing spatial distribution.
(*a*) Average voidage, 0·27.
(*b*) Average voidage, 0·22.

Right: Frequency distribution of local voidage.
(*a*) Average voidage, 0·27.
(*b*) Average voidage, 0·22.

ordered arrangements of spherical particles are of little assistance.

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Measurement of High Voltages

ABSOLUTE measurements of high voltages, up to about 300 kilovolts, have been carried out by various workers using instruments of the attracted disk type, as originally devised by Lord Kelvin, in which the electrostatic deflecting force on the disk is balanced by mechanical means. When such instruments are operated in air, large spacings are necessary for the higher voltages, and difficulties arise in the production of a uniform field without the use of excessively large electrode diameters. This has been overcome to some extent by one group of workers[1], who have enclosed the cylindrical space between the electrodes with a series of guard-rings. In another arrangement[2], the apparatus is operated in compressed gas, with a consequent reduction in the spacing between the electrodes for a given voltage.

It has occurred to us that there are considerable advantages to be obtained by the enclosure in vacuum of the attracted disk electrometer, and of other forms of electrostatic voltmeters. The working voltage gradient for instruments operating in air is limited to a value below about 10 kV. per cm., whereas, in vacuum, a voltage gradient of more than 100 kV. per cm. can be used. For a given voltage, therefore, the spacing between the electrodes in vacuum can be reduced to less than one tenth of that in air, so that the production of a uniform field between the electrodes can be simplified and a more compact form of instrument can be made. As the attractive force between the electrodes varies as the square of the voltage gradient, a greater mechanical precision is possible for the vacuum-enclosed instrument; an attractive force of 4·5 gm. per cm.^{2} of electrode area may be obtained in vacuum for a gradient of 100 kilovolts per cm.^{2} as compared with 0·045 gm. per cm.^{2} at 10 kilovolts per cm.^{2} in air.

An attracted disk electrometer enclosed in a continuously evacuated system is now being constructed, and will be used for the absolute measurement of both A.C. and D.C. high voltages. Little difficulty is anticipated in obtaining an accuracy of within 0·3 per cent in the measurement of voltages of 100 kilovolts or more.

On account of the large deflecting force available, the instrument can be made of more robust construction than one operating in air, and an improved accuracy and greater reliability of indication can be obtained. There is an absence of convection currents, which is one of the causes of difficulties in the operation of the air type of instrument. Also there is freedom from interference by dust and humidity.

Similar advantages to those claimed above for the attracted-disk electrometer are obtained in direct-reading electrostatic voltmeters when these are enclosed in vacuum. Several of these instruments are being developed, for various voltage ranges, extending from several kilovolts to hundreds of kilovolts. One such instrument has already given satisfactory operation in the measurement of voltages between 50 and 100 kilovolts. Although continuous evacuation is used in the present designs, it is intended later to seal the mechanism in a glass-metal envelope.

Further information concerning these developments will be published in due course.

We express our appreciation to Sir Arthur P. M. Fleming, director of research and education, Metropolitan-Vickers Electrical Co., Ltd., for permission to publish this note.

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Anodic Deposit of Protactinium

PREVIOUSLY described experiments[1] have shown that under certain conditions of electrolysis of sulphuric or hydrofluoric solutions of protactinium, this element can be deposited on the cathode, at least in extremely thin layers. I have now observed, in sulphuric solutions, an anodic deposit on a lead oxide (PbO_2) support. Normal solutions of sulphuric acid containing about 10^{-5} gm. of protactinium in presence of 1 or 2 mgm. of zirconium sulphate were used. With a cathode of platinum, an anode of platinum covered with lead oxide (PbO_2) and a current of 5–20 mA./cm.^{2}, the yield is 30–60 per cent after two or three hours, with moderate stirring. Under these conditions the deposit on the cathode is insignificant. An anodic deposit can also be observed on gold anodes, but these electrodes are severely attacked. I have never observed an anodic deposit on pure platinum electrodes. The yield is reduced if sulphuric acid is replaced by nitric acid.

The influence of the nature of the anode is not due to a difference in oxygen overvoltage. Measurements of the potential of the three types of electrodes against a calomel electrode were carried out and have shown, for a given current density, no significant difference; if anything, electrodes covered with lead oxide show a smaller positive potential than the platinum and gold ones. It is known, however, that PbO_2 anodes favour electrolytical oxidations; for example, the formation of chromic and periodic acid.

As to the nature of the deposit, it is still uncertain. Usually, metallic peroxides formed at the anode correspond to a state of valency of the metal superior to the normal. The valency of protactinium in sulphuric solutions being already 5, what can be the valency of the anodic peroxide?

The investigation is being continued in order to clear up this question, as well as the mechanism of the deposition.

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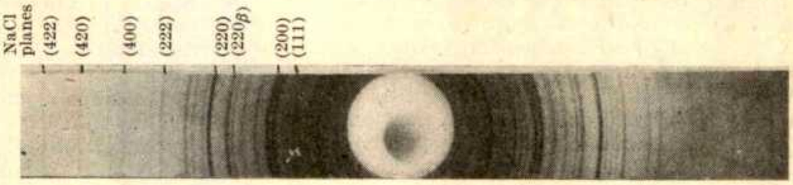
X-Ray Study of the Solution of Alkali Halides in Borax and B_2O_3 Glass Systems

A NUMBER of salts including alkali halides dissolve readily in glass. It has been suggested by S. K. Majumdar and R. M. Palit[1] that an X-ray investigation of the nature of these salts in the dissolved state inside the glass medium would be interesting. Such a study is naturally expected to give information regarding whether these salts form ionic, molecular or colloidal solutions, combine chemically with the glass medium, or induce any crystallinity in the glass itself. An investigation in these directions is being carried out in this laboratory.

Powder photographs of various alkali halides dissolved in glassy B_2O_3 and borax were taken at different concentrations and compared with powder photographs of the crystals of these substances. In the case of sodium chloride dissolved in borax, all the lines of sodium chloride and some lines which belonged neither to it nor to any of the known crystalline sodium borates appeared, as shown in the accompanying reproduction. The positions and relative intensities of the sodium chloride lines were identical with those of the pure salt. The sharpness of these lines indicates that *crystallites* of sodium chloride enter into glass. The average size of the particles in these colloidal solutions is under investigation. The only effect of using different concentrations of sodium chloride in borax was that the intensities of the sodium chloride lines increase with concentration. In the case of sodium chloride dissolved in B_2O_3 glass, the results were similar except that the new unidentified lines appeared only in weak solutions. For potassium chloride dissolved in borax and B_2O_3, the results were again similar; while in the case of rubidium chloride only the lines of pure rubidium chloride were obtained.



Thus we find that the alkali halides form colloidal solution in glass; the particle sizes are sufficiently large as to give sharp reflexions. Determination of the average size of these crystallites by measuring the half-intensity widths of these lines is in progress. Attempts are also being made to trace the origin of the extra lines that have been observed in the cases of dissolved sodium chloride and potassium chloride.

Two of us (S. K. M. and B. K. B.) are grateful to the Board of Scientific and Industrial Research of the Government of India for financial help.

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Harmonics in the Piezo-Electric Oscillation of a Quartz Crystal

S. Parthasarathy, A. Pande and M. Pancholy[1] have recently given evidence of oscillation of the quartz crystal not only at odd harmonics but also at even and half-odd harmonics. In the third column of Table 1 in their communication, there are fourteen values of the ratio of the frequency to the fundamental which they got from a single quartz plate: 0·499, 1·00, 1·465, 1·96, 2·69, 3·00, 3·50, 4·00, 4·40, 5·00, 5·35, 6·23, 7·04, and 8·00.

In the course of an experiment on supersonic waves propagated in liquid, we have also noticed the harmonics produced by the piezo-electric oscillation of a quartz crystal on the background of a continuous range of frequencies of oscillation. The electric circuit we used was an ordinary Hartley type with an output of about 6 watts only. Eleven quartz plates, of different shapes, circular, rectangular and square, were used. They were cut and ground in this Institute, except one which was given to us in exchange by the American Air Force in Kunming. They were either *AT*-cut or *X*-cut, and no thickness variation on each plate more than 0·005 mm. was observed.

The quartz plate was clamped on a holder immersed in distilled water. A hot-cathode sodium discharge lamp of 40 watts was used as light source. The diffraction pattern was observed with a reading telescope of focal length 247 mm. The frequency of oscillation was measured with a G. E. wave-meter of precision type.

As soon as the electric circuit began to oscillate, the diffraction pattern appeared; as the frequency of the electric circuit increased by turning the condenser in the tank circuit, the spacing between the diffraction lines was gradually and continuously widened. The diffraction pattern usually gave one or two orders. However, at certain particular frequencies, the milliammeter in the plate circuit recorded a sudden jump; at the same time the diffraction pattern went up to a higher order and its intensity abruptly increased. For example, one of eleven quartz plates was a circular disk of 18 mm. in diameter and 1·337 mm. in thickness. It was *X*-cut, and its fundamental frequency measured 2,080 kc. It was then submitted to the electric circuit for oscillation. From 2,000 to 14,000 kc. there were twelve frequencies where the jumps on the milliammeter occurred and the order and intensity of the diffraction pattern increased. The exact values of the ratio of the frequency to the fundamental were found to be 1·00, 1·72, 1·94, 2·04, 2·16, 2·65, 3·00, 3·13, 4·00, 4·45, 5·00, 6·20. They were believed to be closely, if not exactly, the odd, even and half-odd harmonics which Parthasarathy and his collaborators found. Throughout the whole range of oscillation, the diffraction patterns never failed to appear, although at certain places they were barely visible even with the help of a telescope.

It will be remembered that the Hartley circuit has a strong feed-back, so the crystal is forced to vibrate. It seems that the quartz crystal can be forced to vibrate over a wide range of frequency as soon as its impedance has been overcome, and that it particularly shows the resonance of vibration at the frequencies of $\frac{p+1}{2}f$, where f is the fundamental frequency of the quartz crystal and p is an integer. The odd harmonics oscillate much more strongly than the even, as is indicated by the intensity and number of orders of the diffraction pattern. If we put the crystal in a Pierce circuit which has a weak feed-back and is generally regarded as less active in oscillation, the crystal only oscillates at its fundamental frequency and odd harmonics. It may be added that in the forced vibration, the harmonic vibrations do not come out very exactly, and they may change their resonance frequencies when a different mode of excitation, as in different conditions of clamping the crystal, is used.

L. C. Tsien.
H. C. Chu.

National Academy of Peiping,
Institute of Physics,
Kunming.
May 1.

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[1] Parthasarathy, S., Pande, A., and Pancholy, M., *J. Sci. and Indust. Res.*, **2**, No. 5, 295 (1944).

Hexachlorocyclohexane as an Insecticide

My attention has been directed to the possibility that Dr. L. B. Bourne's letter[1] may be read as implying that Dr. E. L. Taylor's reference[2] to hexachlorocyclohexane, supplied by Imperial Chemical Industries, as a "new" insecticide was unjustified in the light of recent information that this material has been available as an insecticide in France for some years.

I am asked to emphasize that it was in the spring of 1943 that I.C.I. made the important and unexpected discovery that the remarkable insecticidal properties of hexachlorocyclohexane are almost entirely associated with only one of the four isomers (gamma) which had first been isolated thirty-one years earlier. The Company, however, was not permitted by the Government to disclose this or the extent to which hexachlorocyclohexane had been manufactured and used as an insecticide in Britain until 1945, when an announcement was made in the Hurter Memorial Lecture (not yet published) to the Society of Chemical Industry on March 8. This discovery of the outstanding insecticidal activity of 'Gammexane', as the gamma isomer has been called, made possible a planned development of hexachlorocyclohexane as an insecticide.

Thus sufficient material was produced to meet the 1943 demands of agriculture for a dust to replace derris, then in short supply, for the control of flea beetle. The material proved so successful, not only in the control of many agricultural and horticultural pests, but also in trials against locusts and industrial pests such as cockroaches, crickets, bed bugs, flies, etc., that production was increased in the following two years and the material was made available for these widely varied applications. Up to the time when the Government permitted the disclosure of the nature of the active constituent of the material, hexachlorocyclohexane equivalent to several thousand tons of insecticidal dust had been produced in Britain.

Sidney Rogerson.

Imperial Chemical Industries, Limited,
Nobel House,
2 Buckingham Gate,
London, S.W.1.

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[1] *Nature*, **156**, 85 (1945).

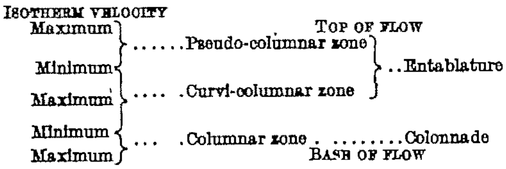
[2] *Nature*, **155**, 393 (1945).

THE GIANT'S CAUSEWAY

"SURE, an' if ould Finn did not build it, how did it come to be there, at all?" Although the world-famous Causeway—justly claimed by Molyneux in 1694 to be "as Remarkable a Natural Curiosity . . . as may be met with in Europe"—has long offered a challenge to geologists, there has hitherto been no satisfactory account of its petrology, structure and geological setting. This singular neglect of a classic area stimulated S. I. Tomkeieff to make a thorough investigation of the basalt lavas of the Causeway and its environment, and just before the War he communicated his results to the Association de Volcanologie in a masterly paper[1] which was printed in Naples in 1940. Fortunately, this eagerly awaited publication has survived, and copies are now available in Britain.

In Antrim a lower series of lavas (olivine-basalts) is normally separated from an upper series (columnar tholeiitic basalts) by a major interbasaltic (lateritic) zone. The sequence is magnificently displayed in the cliffs adjoining the Causeway. The Causeway itself is a terrace carved by the sea from the lowest of the tholeiitic flows, the base of which, to be seen only at very low tide, has been found by Mr. Tomkeieff resting directly on fresh olivine-basalt belonging to the lower series. On each side of the Causeway, however, the columns rest on the interbasaltic zone at a height of about 70 ft. above sea-level. The basalt flow of the Causeway is therefore regarded as having filled a river valley excavated through the interbasaltic zone into the underlying olivine-basalts. The divergent arrangement of the columns, at right angles to the valley sides, fully accords with this simple interpretation of the apparently anomalous position of the flow where it forms the Causeway.

In vertical section, columnar lavas of the Causeway type have a conspicuous two-fold arrangement for which a new terminology is proposed. The lower zone of vertical polygonal columns is referred to as the 'colonnade', while the upper zone of less regular jointing is distinguished as the 'entablature'. The latter is subdivided in turn into a lower 'curvi-columnar' zone (thin, curving columns, often radiating from marginal points) and an upper *pseudo-columnar* zone (thick, short polygonal blocks) which is usually surmounted by a thin slaggy and vesicular zone. The different joint systems responsible for these structural zones are most ingeniously explained by Mr. Tomkeieff as consequences of the varying velocity of propagation of isotherms during the cooling history of a flow. From the calculated distribution of temperature in a cooling sheet, curves are drawn indicating the temperature reached at different levels at the ends of successive and equal time intervals, and from these curves others are derived showing the velocity of the inward progress of the isotherms. The velocity-of-propagation curves show three maxima (one at each margin and one in the middle) with two minima between. The latter divide the sheet into three parts which are correlated with the three sets of structures seen in each flow. The rate of advance of the critical isotherm corresponding to the fracture-point determines the nature of the jointing, while the amount of the accumulated stress determines its magnitude. The free surface and the high initial velocity of the isotherms at the top controls the widely spaced, crude jointing of the pseudo-columnar zone, while the absence of a free surface at the base and the smaller initial velocity of the isotherms gives rise to the more closely spaced joints of the colonnade. Between the two minima, each of which corresponds to a pause in the fracture process, an unfractured zone remains sandwiched for a time. Eventually the final rapid increase of isotherm velocity, and therefore of stress accumulation, promotes an increased tensile strength (on analogy with the behaviour of glass rods), and so leads to overstraining which culminates in the violent fracturing represented by the tangle of wavy joints characteristic of the curvi-columnar zone.



After the formation of the columnar fissures, escape of gases from the cooling lava would be greatly facilitated, and as expanding gases are a most efficient cooling agent, the temperature of the margins of the columns would rapidly fall. Contraction of the outer part of a column would throw it into compression, while tension would gradually develop in the inner part. A cross-rupture would originate at the point of maximum tension somewhere inside the column and would spread rapidly round and then inwards and outwards, giving rise to a curved joint representing the first stage in the formation of a transverse 'ball-and-socket' joint. Minute variations in the delicate interplay of the principal stresses would determine whether a given joint curved upwards or downwards. Occasionally a fracture originating some way from the centre would fail to reach the centre, so bringing about the formation of a central knob, a feature that has long defied explanation. The outward progress of the curved fracture would normally stop along the circular line of no stress, to be completed by later fracturing as a horizontal lip. Sometimes, however, the original fracture would overshoot this limit and spread evenly to the margin. Both the central knobs and, generally, the outer lips have a granular fracture of later origin than the glossy fracture of the initial, curved joints.

It is pointed out that freshly opened joints in the tholeiitic lavas show glossy surfaces, with parabolic, radiating or feathery markings, which closely resemble fracture surfaces in glass. This similarity, the fine-grained and uniform texture of the rock, and the presence of interstitial palagonite and glass, all suggest that the fissuring took place while the lava was still in a semi-glassy or even glassy state. On the other hand, the olivine-basalts were probably crystallized completely before fissuring. Their joint-planes have a granular surface and the rock is of much coarser grain and lacks a glassy mesostasis.

Former petrographic descriptions of the Causeway basalt and its associates have been no more than brief notes. Mr. Tomkeieff now gives us a detailed account, including the mineralogy, modal composition and granularity of the flows above and below the major interbasaltic zone, together with new chemical analyses of the colonnade and entablature of the second of the upper flows. A good analysis of the Causeway basalt itself has been available since 1936 [2]. Other topics dealt with include the origin and mode of eruption of the lavas. The suggestion that the Antrim lavas belong to a multiple-vent type of shield-complex is favoured, in agreement with the recent conclusion of the Geological Survey that the lavas of the British Tertiary province were not necessarily erupted, as previously thought, through dyke-fissures.

Finally, it should be recorded that the history of 250 years investigation is most entertainingly summarized and fully documented. By his outstanding success in grappling with a group of problems that has tantalized many generations of "Inquisitive Naturalists", Mr. Tomkeieff has far outdistanced his predecessors. He is to be congratulated on a contribution which, for the first time in the history of the Causeway, may be hailed as thoroughly worthy of its impressive subject. ARTHUR HOLMES.

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[1] Tomkeieff, S. I., *Bull. Volcanologique*, II, 6, 89 (1940).

[2] Holmes, A., *Proc. Roy. Irish Acad.*, 43 B, 91 (1936).

THE FILM IN SCIENCE

A CONFERENCE on "The Film in Science", organized by the Scientific Film Association, was opened at the Technical College, Huddersfield, on August 31, after a civic reception by the Mayor, Alderman Sidney Kaye; over 100 were present.

Mr. Geoffrey Bell (deputizing for Mr. Arthur Elton, president of the Association, who was in Denmark) said that the conference gave an opportunity for many different users of scientific films to state their needs and problems. That the Conference was held in the provinces implemented the Association's aim to be fully representative of Britain rather than metropolitan in character. The Scientific Film Association could bring to a focus the growing scientific culture partly represented by scientific film societies all over Britain—and also shown, significantly, by the chance that the B.B.C. on the following Sunday was broadcasting its first review of scientific films. He added that the pressure of events has now made it clear that a widespread understanding of what science stands for, long recognized as desirable, is a matter of the most vital necessity; and films can help to bring about this understanding.

Miss Dorothy Grayson (educational representative of the British Film Institute), speaking on "The Science Film in Education", said that one of the duties of science is to protect people from making blind assumptions. Films should fall into three categories: those which deal with the established sciences; those presenting the facts as known, with some attempt to derive conclusions from them; and those which give education in doctrines and values. "We always pretend," said Miss Grayson, "that schooling contains no element of propaganda, but we should be wiser if we faced the realization that it does. We try to pretend that we as teachers deal only with the facts, and that our own personalities and convictions never seep through. This is not true. The children do get their values very largely from environment, but these also come from the deliberate purposive education given in schools. Instruction and practice in critical deduction is very necessary." In school the film is especially valuable as a tool of exposition. The screen can bring into juxtaposition events separated in time and space, it benefits research inquiry by adjusting time- and sight-scales, and it makes history a living thing. The films also present the teachers' factual material in ampler form and leave them free to concentrate on interpretation. There should be abolition of customs duties on all educational films which merit international circulation, and a subsidy for the development of such work is also badly needed.

On the morning of September 1, Mr. W. F. Andrews (head of the Department of Chemistry, Physics and Biology, Doncaster Technical College), speaking on "Scientific Film Needs in Technical Training", said that from many years of experience he realized the need for three types of film covering the requirements of primary, secondary and advanced technical training. Mr. H. Richmond (head of the Mining Department, Doncaster Technical College) described the "Film Strip in Technical Training", emphasizing its value for revision purposes. He showed a strip which has been used as an introductory aid for acclimatizing mining trainees to pit work. Both speakers stressed the need for an immediate supply of such visual material, the value of which was demonstrated during the War in technical training for the Services.

In the afternoon, the use of the "Film as an Instrument of Scientific Research" was described and demonstrated by Mr. Derek Stewart (Kodak Research Laboratories). After a short historical account of the technical development of cinematography, he dwelt at some length on the various ways in which the modern camera has been perfected for specialized purposes. High speed enables as many as 3,000 exposures per second to be taken. Reductions in apparent speed of up to 200 to 1 are therefore obtainable when projecting such pictures at the normal rate. This technique has made valuable contributions to the analysis of motion of rapidly moving machinery and to the study of the mechanism of explosions. At the other end of the scale, time-lapse photography, used to such fine purpose by the late Percy Smith, has served to speed up the apparent rate of motion of slow-moving processes. Biological growths, for example, taking many months in real life, can thereby be presented visually and as a homogeneous whole in the space of a few minutes.

In the evening, Mr. Basil Wright (producer at the Crown Film Unit) talked on "Film Production". He emphasized that the new art of the film is only possible through the co-operation of many workers skilled in different spheres. Even if the exceptional man did all his own scripting, directing and cutting, he would be almost certain to have his processing done commercially. In the professional field, this means that film-making demands highly developed team-work. One aspect of this is the relationship between director and producer, best explained perhaps by saying that the producer has to see the wood while the director looks for the trees. In subsequent discussion, the need for instruction in film-making was emphasized. Medical men and scientific men would thereby be enabled to produce film records valuable as a means of exchanging ideas and imparting information. The existence at the University College, Exeter, of the first Visual Education Centre in Britain is a significant step towards academic recognition.

There followed a reading, in his absence, of a paper by Mr. Frank Goodliffe (director of Science Films) on the making of that most valuable part of the scientific film, the animated diagram. This was illustrated by the screening of one of his films.

On September 2, under the chairmanship of Surgeon Lieut.-Cmdr. R. C. MacKeith (chairman of the Medical Committee of the Scientific Film Association), there was a discussion on "The Film in Medicine", together with a show of films on public health and of specialized films for medical men and medical students. The need for presenting each subject from many different angles and in the light of opposing schools of thought was stressed by a delegate from South Wales, supported by many others. After seeing the film "Defeat Tuberculosis", he said that, admirable though it was in showing the cure of the disease under ideal clinical conditions, it might nevertheless lull the public, to whom it was designed to be shown, into a false sense of security. Apart from allaying the fear of 'T.B.' in the public mind, it should also have emphasized the urgent necessity for providing the ideal facilities to all who may be in need of them.

The value of the film in teaching medicine, and in particular, surgery, was demonstrated by a professionally made film on "Transplantation of Cornea Autokeratoplasty", as well as by an amateur production by three medical men from the Westminster Hospital on an "Introduction to Acute Inflammation".

Dr. W. T. Astbury (director of the Textile Physics Laboratory, University of Leeds) gave a lecture on 'X-Ray Adventures among the Proteins and other "Molecular Giants" on September 2. In this talk, garnished with a pleasant humour and illustrated by slides and 'working' models of proteins and fibre molecules, Dr. Astbury emphasized his conviction that the mere imparting of knowledge is not enough. Films should be made which show the quest for ultimate knowledge to be a dramatic and exciting adventure.

During the Conference, delegates inspected an exhibition of projectors and other visual aid equipment; spare projectors were kept busy running amateur-made films, and film strips. The scientific ilm review, broadcast in the Sunday evening "Science Magazine", interested many. Discussions followed all the lectures, and the Conference ended with a long programme of scientific films.

The Scientific Film Association will publish a full account of the proceedings as soon as possible.

TYROGLYPHID MITES AND HUMAN DISEASE

STUDENTS of applied zoology are familiar with the damage caused by Tyroglyphid mites to stored products valuable to man. The part they may play in the causation of disease is less well known.

Sir Philip Manson-Bahr and W. J. Muggleton (*Lancet*, 81, Jan. 20, 1945) direct attention to the ossible significance of mites and their eggs in human fæces. Invasion of the human alimentary, urinary nd respiratory tracts by tyroglyphid—and sometimes also by tarsonemid—mites has been reported y M. Khalil (*Proc. Roy. Soc., Med.*, 14, Sect. Trop. Dis., 24; 1921), who found the eggs of *Aleurobius farinæ* in 8 per cent of 130 Cornish miners; by J. Mackenzie (*J. Roy. Army Med. Corps*, 39, 339; 1922), ho found *A. farinæ* and *Tarsonemus* in recruits suffering from nocturnal enuresis and in one suffering om hæmaturia; and by others who found various mites in human sputum. The evidence about the possible effects of mites in the human alimentary canal has been reviewed up to 1929 by A. Hase (*Z. Parasitenkunde*, 1, 765; 1929). Some experts think that such common mites as *Glyciphagus domesticus*, *Aleurobius farinæ* (in meal) and the cheese mites *Tyroglyphus siro* and *T. longior* can be pathogenic if great numbers are eaten; others deny this. The dermatitis suffered by people who handle mite-infested foodstuffs (Grocer's itch, copra itch) is, however, well known (see *Lancet*, 351, Sept. 9, 1944). Manson-Bahr has seen dead mites in human fæces from time to time, and during the past year has been finding them with increasing frequency. Recently, eggs showing development from the morula stage to the newly hatched nymph have been found in the fæces of two patients. The mites could not be identified with certainty, but were probably *Tyroglyphus siro*. One of the patients had had recurrent diarrhœa and had come from the Isle of Man, where he had eaten much over-ripe cheese. Search for similar mites in the rationed cheese now being sold in Britain has failed. Manson-Bahr and Muggleton conclude that, so far as can be ascertained at present, the presence of mite eggs in human fæces has no pathological significance.

The possible effects of mites upon the respiratory tract are the subject of a paper by E. Soysa and M. D. S. Jayawardena (*Brit. Med. J.*, 1, Jan. 6, 1945) on pulmonary acariasis. During 1943–44 these authors observed a remarkably heavy incidence of bronchial asthma among patients in a hospital of the South-East Asia Command. From January 1942 until June 1944 bronchial asthma was responsible for 48 per cent of all respiratory cases and for 21 per cent of cases invalided out of the Army through this hospital. Some patients showed a high eosinophilia, which in asthma may be, according to Osler, as high as 53 per cent. But the patients rarely gave a family history of asthma or of other allergic symptoms; their eosinophilia was not due to intestinal parasites; drugs commonly given to relieve asthma gave only temporary relief to these patients, and their eosinophilia persisted. Major T. R. Jansen referred the authors to a civilian patient who had asthma with high eosinophilia, and mites were found in his sputum; he made a remarkable recovery after administration of pentavalent arsenic. Referring to the work in Ceylon of H. F. Carter, G. Wedd and V. St. E. D'Abrera (*Ind. Med. Gaz.*, 79, 163; 1944), who recovered species of *Tyroglyphus*, *Tarsonemus*, *Carpoglyphus*, *Glyciphagus* and *Cheyletus*, all common in stored products, dust, debris, etc., from 17 out of 28 patients, and found that arsenical treatment reduced both the numbers of the mites and the eosinophilia, Soysa and Jayawardena record their own observations.

The whole problem and its relevant literature is discussed by Soysa and Jayawardena, who found, as others have done, that treatment with arsenical preparations (they used 'carbasone' or 'stovarsol') was satisfactory. While the existing evidence does leave some doubt whether mites can alone cause all the asthma-like symptoms described, the problem requires further investigation. The differential diagnosis between this asthma-like condition and tuberculosis and other obscure and transient respiratory conditions with asthma-like symptoms and eosinophilia (for example, Loeffler's syndrome) may be especially difficult.

That monkeys of the genus *Macacus* suffer from pulmonary lesions in which mites are found is shown by L. J. Davis (*Brit. Med. J.*, 482, April 7, 1945), who quotes F. D. Weidman (*J. Parasit.*, 2, 37; 1915) on the acarids which he found in the lungs of *Macacus rhesus*. Davis found in the lung lesions of a species of *Macacus* (the species is not stated) mites which probably belonged to the genus *Pneumonyssus*, and he suggests that these mites may be normal ectoparasites of these monkeys, so that monkeys could readily inhale these mites. Experimental infestation of monkeys with them might, he suggests, help us to understand the problem of infestation of the human lung with mites. Davis says that the lesions in the monkey's lung resembled, to the naked eye, the lesions of early tuberculosis. This recalls the similar resemblance to tuberculous lesions of the lesions of organs other than the lung, for example, those of the mesenteric glands, caused by larvæ of the degenerate Arachnid *Linguatula*. But there is much histological evidence that lesions caused by parasitic nematodes (for example, various Filarioid species) may also resemble those due to tuberculosis. It is clear that the solution of this whole problem will require all the skill of the clinician, the pathologist and the biologist.

G. LAPAGE.

FORTHCOMING EVENTS

Tuesday, October 9

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 1.30 p.m.—W. V. Grigson: "The Aboriginal in the Future India".

INSTITUTION OF CHEMICAL ENGINEERS and CHEMICAL ENGINEERING GROUP (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Dr. E. R. A. Merewether: "Industrial Health—Progress, Contrasts and Fallacies".

ILLUMINATING ENGINEERING SOCIETY (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 6 p.m.—H. C. Weston. Presidential Address.

SHEFFIELD METALLURGICAL ASSOCIATION and SHEFFIELD BRANCH OF THE INSTITUTE OF BRITISH FOUNDRYMEN (Sheffield Metallurgical Club, 198 West Street, Sheffield, 1), at 7.0 p.m.—H. O. Howson: "The Formation of Banded Structures in Horizontal Centrifugal Castings".

Wednesday, October 10

ROYAL SOCIETY OF MEDICINE, SECTION OF COMPARATIVE MEDICINE (at 1 Wimpole Street, London, W.1), at 2.15 p.m.—W. A. Pool: "A Plea for the Eradication of Tuberculosis in Cattle in Great Britain" (Presidential Address).

INSTITUTION OF ELECTRICAL ENGINEERS, RADIO SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. A. H. Mumford: Inaugural Address as Chairman.

SOCIETY OF CHEMICAL INDUSTRY (joint meeting of the NEWCASTLE SECTION with the ROYAL INSTITUTE OF CHEMISTRY) (in the Chemistry Lecture Theatre, Newcastle-upon-Tyne), at 7 p.m.—Dr. H. Baines: "The Choice of Photographic Materials for Scientific Purposes".

INSTITUTE OF WELDING, NORTH LONDON BRANCH (at the South-West Essex Technical College, Walthamstow, London, E.17), at 8 p.m.—"X-Rays and their Use in Weld Testing", Dr. R. J. Barnes: Part 1, "Plant and Equipment", Dr. S. Torrence: Part 2, "Use and Applications".

Thursday, October 11

ROYAL COLLEGE OF SURGEONS (at Lincoln's Inn Fields, London, W.C.2), at 5 p.m.—Sir Howard Florey, F.R.S.: "The Use of Micro-organisms for Therapeutic Purposes" (Lister Memorial Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS, INSTALLATIONS SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. Forbes Jackson: Inaugural Address as Chairman.

SOCIETY OF CHEMICAL INDUSTRY, ROAD AND BUILDING MATERIALS GROUP and LONDON SECTION (at Gas Industry House, 1 Grosvenor Place, London, S.W.1), at 6 p.m.—Prof. E. K. Rideal, F.R.S.: "Some Physico-chemical Problems in Construction".

ASSOCIATION OF SCIENTIFIC WORKERS, LONDON AREA (in the Caxton Hall, Westminster, London, S.W.1), at 7.0 p.m.—Report on Visit of British Men of Science. Prof. D. M. S. Watson, F.R.S., Dr. W. A. Wooster, and others.

ROYAL INSTITUTE OF CHEMISTRY, LONDON AND SOUTH-EASTERN COUNTIES SECTION (at the Public Library, William Street, Slough), at 7.0 p.m.—Dr. J. M. Walter. "Recent Advances in Plastics".

Friday, October 12

RESEARCH DEFENCE SOCIETY (at Manson House, Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, London, W.1), at 3.15 p.m.—Sir William Savage: "Public Health and its Debt to Experimental Medical Research" (Stephen Paget Memorial Lecture).

ROYAL ASTRONOMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Prof. Bengt Edlén. "The Origin of the Emission Lines in the Coronal Spectrum" (George Darwin Lecture).

INSTITUTION OF MECHANICAL ENGINEERS (Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—W. G. A. Perring: "The Mechanism of the German Rocket Bomb (V.2)" (Lantern Lecture).

INSTITUTE OF WELDING, BIRMINGHAM BRANCH (at the James Wat Memorial Institute, Great Charles Street, Birmingham), at 6.30 p.m.—Dr. E. G. West: "Developments in the Welding of Aluminium Alloys".

SOCIETY OF CHEMICAL INDUSTRY, SOUTH WALES SECTION (at the Royal Institution, Swansea), at 6.30 p.m.—Mr. F. Gill: "New Physical Methods in Examining Petroleum Products".

BRITISH ASSOCIATION OF CHEMISTS, ST. HELENS SECTION (at the Y.M.C.A. Buildings, St. Helens), at 7.30 p.m.—Mr. H. Pritchard "Chromatography".

Thursday, October 11—Thursday, October 25

ELECTRICAL ASSOCIATION FOR WOMEN Twenty-first Birthda Celebrations, at Dorland Hall, Lower Regent Street, London, S.W.1

October 11, at 11 a.m.—Opening by Duchess of Kent.

October 12, at 2.30 p.m.—Sir Robert Watson-Watt, C.B., F.R.S. "Women and Wireless." Dr. Kathleen Lonsdale, F.R.S.: "A Woman Physicist Looks Back". Sir Harry Railing: "After the Scientist, the Engineer".

October 12 and 13. Annual Conference of the Women's Engineering Society. Miss M. M. Partridge: "The Next Twenty-one Years" (Presidential Address).

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on o before the dates mentioned.

SCIENTIFIC OFFICER FOR POTATO INVESTIGATIONS at the Nationa Institute for Agricultural Botany, Huntingdon Road, Cambridge—The Secretary (Oct. 10).

A LECTURER and an ASSISTANT LECTURER IN ZOOLOGY in th University of Birmingham—The Secretary (Oct. 13).

EDUCATIONAL ADMINISTRATIVE OFFICERS (male and female) to dea with universities, adult education, technical colleges, youth activitie and other aspects of the control of German education in the Britis Zone of Occupation—Appointments Department, Ministry of Labou and National Service, Sardinia Street, London, W.C.2, quoting Re No. O.S.1118 (Oct. 15).

TEACHER OF MECHANICAL ENGINEERING SUBJECTS, and a TEACHE OF PHYSICS, at the Acton Technical College, High Street, Acton London, W.3—The Principal (Oct. 15).

LECTURER IN INORGANIC CHEMISTRY in University College, Nottingham—The Registrar (Oct. 20).

LECTURER IN ORGANIC CHEMISTRY at the City of Liverpool Technica College—The Clerk to the Local Education Authority (Oct. 20).

LECTURER IN GENERAL ENGINEERING SUBJECTS, and a LECTURE IN ENGINEERING MATHEMATICS, in the Merchant Venturers' Technic College, Bristol—The Principal (Oct. 20).

CHIEF SUPERINTENDING ENGINEER (Ref. No. C.2840 XA), ASSISTAN CHIEF ENGINEER (Ref. No. C. 2841.XA), MECHANICAL ENGINEER (Ref. No. C.2842.XA), for a paper mill in India—The Ministry o Labour and National Service (Appointments Department), Technic and Scientific Register, Room 670, York House, Kingsway, London W.C.2 (Oct. 22).

LECTURER IN PHILOSOPHY in the University of Birmingham—Th Secretary (Oct. 27).

HARBOUR ENGINEER for harbour construction and maintenanc for the Sudan Railways—The Ministry of Labour and National Servic Appointments Department, Technical and Scientific Register, Roo 670, York House, Kingsway, London, W.C.2, quoting E.1962 (Oct. 31).

DIRECTOR OF THE BRITISH ELECTRICAL AND ALLIED INDUSTRIE RESEARCH ASSOCIATION, 15 Savoy Street, London, W.C.2—The Chairman (Nov. 16).

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LECTURER IN SOCIOLOGY at Bishop Otter College, Chichester—T Principal.

TEACHER (man or woman) OF BIOLOGY at the Wolverhampton a Staffordshire Technical College—The Clerk to the Governors, Educ tion Offices, North Street, Wolverhampton.

University College ... PHYSICS DEPT.

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CONTENTS

Page
Demobilization, Rehabilitation and Land Use . . . 429
Problems of the Modern University. By R. Brightman 432
Colour for Analysts. By A. L. Bacharach 434
Science and Pig-keeping. By Dr. John Hammond, F.R.S. 434
The Corrosion of Metals 435
Sex Education : Aims, Possibilities and Plans. By Cyril Bibby 438
Family Food Consumption in the United States. By Miss M. W. Grant 441
Obituary :
  Mr. E. Lancaster-Jones. By Dr. H. Shaw . . . 442
News and Views 443
Letters to the Editors :
  Detection of Birds by Radar.—David Lack and G. C. Varley 446
  Autotrophic Flagellates as the Major Constituent of the Oceanic Phytoplankton.—Dr. W. R. G. Atkins, O.B.E., F.R.S. 446
  Occurrence of the Diphyllobothriidæ in Ireland.—J. R. Harris and Dr. M. D. Hickey 447
  Periodate Oxidation of Sugars in Neutral Phosphate Buffer.—Gösta Lindstedt 448
  Influence of Vitamin E on the Utilization of Carotene from Oils.—S. Dattatreya Rao 449
  Frost Injury Simulating Virus Disease Symptoms on Potato Foliage.—Robert McKay and Dr. Phyllis E. M. Clinch 450
  An Arsenic-Resistant Tick.—Prof. J. Omer-Cooper and A. B. M. Whitnall 450
  Electric Discharge on a Dielectric Surface (Lichtenberg Figures).—A. Morris Thomas 451
  Formation of an Addition Compound of Calcium Silicate and Sodium Fluoride.—Cyrill Brosset . 451
  Emission Bands of the Fluctuation Type in the Spectrum of Iodine.—Prof. R. K. Asundi and P. Venkateswarlu 452
Carnegie Institution of Washington : Annual Report . 453
The British Pig-raising Industry. By Dr. J. E. Nichols 454
Research in the U.S.S.R. on Conditioned Reflexes . 455
Chemically Stabilized Paper Capacitors 455

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DEMOBILIZATION, REHABILITATION AND LAND USE

THE orderly release of men and women from the Armed Forces was rightly given first place in the domestic policy of the Government as outlined in the King's Speech at the opening of Parliament and in the Prime Minister's speech in the debate which followed. Subsequent events such as the sudden termination of Lend-Lease have only further emphasized that demobilization is the first and most urgent domestic issue in Britain.

Speed is indeed the essential factor in the success of any demobilization scheme, and while it can be claimed that the plans set forth in the White Paper last autumn are elastic, administrative action has been slow to give effect to that elasticity in accordance with the new situation. Much has been done, too, to educate public opinion as to the basic requirements in reconstruction plans : that is one outcome of the numerous schemes and plans for the reconstruction of Plymouth, Norwich, Manchester and other cities and towns which have been published during the last year or so. There is general appreciation that Government direction is a first need ; and the scepticism or dissatisfaction with which some pronouncements from the Ministry of Town and Country Planning and also the announcement of a Committee on National Parks have been received, make the more welcome the pledge in the King's Speech to formulate proposals to deal with the key problems of compensation and betterment in relation to town and country planning, as well as to improve the procedure for the acquisition of land for public purposes and to promote the best use of the land in the national interest. Moreover, in the recent War Office indication of its desire, if not intention, to keep its gunnery range at Harlech, we have had another example of the way in which departmentalism may defy the whole purpose of the War Works Commission and jeopardize not only at Harlech but elsewhere amenities, plans for rural improvement, housing, water-supply, road-making and other essential features of a national plan.

The relation of reconstruction plans as a whole to demobilization and the re-allocation of man-power, and the way in which demobilization as determining the available man-power is even more urgent than housing, the restoration of the export trade, or the provision of goods for civilian needs, is well brought out in a broadsheet "Framework of a Four Year Plan" issued by Political and Economic Planning. To what is said there as to the need for a four-year plan embodying a time and progress schedule for economic reconstruction, the main essentials of which are clearly understood by every citizen, the new situation following on the sudden termination of the War with Japan only adds emphasis. The broadsheet assumes that the War in the Far East would end late in 1946, and the priorities with which it is largely concerned and which are of the essence of a four-year plan have now become a matter of great urgency. The grave problems confronting the United Nations Relief and Rehabilitation Administration, the implications of the attempt to rehabilitate Europe or even to relieve distress and prevent famine are scarcely yet understood in Great Britain, and even less in the United States. Until needs are balanced against resources and the maximum national production obtainable with our limited resources estimated, we cannot draw up the man-power budget referred to in the White Paper on Employment Policy, and without which no employment policy can be effective.

It is true that since the *Planning* broadsheet was published the outlook on defence has been radically changed by the advent of the atomic bomb as well as by the collapse of Japan. Decisions on the speed of demobilization, however, do not depend altogether on decisions on the ultimate size of the Armed Forces. Several millions must be demobilized in any event, and we cannot afford the waste of unemployment, whether disguised in uniform or not. Psychological reasons also stress the importance of speed, though here an equal essential is that the Government's policy should be clearly explained to all those whom it affects.

The value of the present broadsheet has not been affected by these fresh considerations, because its presentation of a man-power budget, following on an attempt to measure the total national production and to estimate how it should be divided between consumer goods and services, public and private investment and the other requirements of public authorities, is put forward as an illustration of how the job should be attacked and what is involved in doing it. In particular, the limiting effect which a bold programme of industrial investment must have on the volume of man-power available to meet consumer needs and especially the requirements of distribution and services must be kept in mind. Moreover, the important conclusion that only by some form of control of entry into the distributive trades can enough man-power be made available in the next four years to ensure the re-equipment and modernization of British industry, a rising standard of living, and, with it, an adequate housing programme, is a timely warning.

The estimate of the 'net national production' in this broadsheet is based on the broad assumptions of total industrial employment of levels of 16·1, 16·4, 17·1 and 17·4 millions for 1946, 1947, 1948 and 1949, respectively, as compared with 16·8 millions in mid-1944, and allowing for a net gain of about 1, 2, 3 and 3·5 million men and women released from the Armed Forces and from Civil Defence; an average working week of the same length as in 1938, but increases of 9, 10·5, 12 and 14 per cent, respectively, in the production per man-hour, with the same terms of trade and with net income from foreign investments, at 1938 prices, of £80 million in each year. Assuming further that the Armed Forces will number 4, 3, 2 and 1·5 millions, respectively, in these years at a cost of £720, 540, 360, 270 million at 1938 prices, *Planning* arrives at an estimate of the net national production of £5,450, £5,430, £5,520 and £5,610 million for the four years in question.

This last assumption is clearly the one that will require most readjustment: it will not be easy to satisfy public opinion on the basis of any figures larger than 3, 2 and 1·5 millions in the Armed Forces for the first three years of the period, even if it is necessary to maintain a level of 1·5 millions for a few further years. It should be noted, moreover, that the latter figure is itself approximately double the level at which it has been computed the Armed Forces could be maintained on a voluntary basis with an intake of 300,000 recruits each year on national service for one year, but excluding trained reserves or 'territorials'. More than this is unlikely to secure public support, and it is evident at once that the man-power situation puts severe limits on our defence policy and in itself indicates the necessity for the speediest possible adjustment to a long-term basis if not to the final peace standard when order has been established.

The observations made in the broadsheet on economic demand, which may be said to arise from three sources—consumption, investment and public authorities' demand for goods and services other than investment—and on the priorities to be assigned not only to these needs but also within the categories between production for the home market and production for export, require much less qualification, and lead to the outstanding conclusion that the first post-war years should be years of heavy investment in building and industrial equipment, for this will be the prerequisite of a rise in productive efficiency and in the standard of living. Moreover, if building is to come first so that war-time damage and arrears can be made good as soon as possible, the resources available for the restoration and modernization of industry and of the public utilities will be drastically limited. Priorities will have to be fixed in peace as in war, and certain controls retained to make them effective.

Vital as investment will be, some rise in consumption should also be contemplated, particularly in regard to non-durable goods and the re-stocking of clothes, shoes, furniture, hardware and the like. At the same time, they should be produced in ever larger quantities for export, and this applies no less to investment goods of all kinds. These considerations lead *Planning* to some assumptions about the broad trends of defence, expenditure, consumption, investment and the foreign balance, and to the presentation of a table of national expenditure for the four years in which the net expenditure at 1938 prices increases from £5,450 millions to £5,610 millions, while expenditure on consumer goods and services increases over the period from £3,190 to £3,770 millions, investment expenditure from £160 in 1946 to £800 millions in 1947 and £915 millions in 1949, while public expenditure on other goods and services decreases from £2,300 millions in 1946 to £1,300 millions in 1947 and then to £1,000 millions.

From these general considerations, the broadsheet attempts to draw up a rough man-power budget for the same period, starting from the targets officially indicated for the building and coal-mining industries. For mining, the labour force is put at 830,000 throughut the period ; with 800,000, 950,000, 1,100,000 and ,250,000 in the building industry for the four years, respectively. Allowance is made for contractions in griculture from 1,100,000 to 1,040,000, and in the number of those employed in public service (including Royal Ordnance Factories, etc.) from 1,550,000 to ,450,000 ; while it is assumed that the total labour orce in the transport (and fishing) industries will emain stationary at the present level of 1,250,000, nd that in the public utility services at 200,000. In distribution it is estimated that numbers will increase rom 2,080,000 to 2,300,000, while those engaged in the professions, banking and insurance, domestic and ther services such as entertainment, hotels, restaurants, etc., are put at 1,450,000, increasing progressively o 1,600,000.

With regard to the most effective distribution of he balance of 6,590,000 in 1946, increasing to ,230,000 in 1949, the re-equipment of industry is onsidered the most important task, and since the ulk of this will fall on heavy engineering ; it is considered that, on the whole, no great change is likely n the numbers employed in spite of war-time expansion. The labour force in the munition industries s regarded as likely to fall considerably from its 944 level but to remain above its pre-war size for ome time, and is estimated at 3·9–3·5 millions or the four years, leaving available for the consumer oods industries and "other manufactures", which nclude building materials, 2·7–3·7 millions for the ame period. If building is given first priority, the man-power available for consumer goods production will be strictly limited and will not regain its pre-war evel of 3·8 millions until after 1949.

Commenting finally on this rough man-power basis or a four-year plan, *Planning* emphasizes that man-power is the most valuable of our resources, and we annot afford to squander it either in a plethora of unproductive services or in the pernicious waste of mass unemployment. Provided we take the necessary measures to avoid these dangers ; that we do not starve industry of the man-power and resources needed for its rapid re-equipment ; that we accept he need for a few years 'austerity' compared with pre-war standards ; and that by our skill and initiative we re-establish our position in world trade ; then there is, in the opinion of P.E.P., no unsurmountble economic obstacle to the achievement of an dequate solution of the housing problem and, generlly, of a steadily rising standard of living. To those rovisos there might well be added one to the effect that the priorities must be determined in the right rder, and that the Government, having made its ecisions, should take the necessary steps not merely o implement them but also to see that they are nderstood by the community generally, and that the reasons for any restraint or controls are fully ppreciated and accepted by those whom they ffect.

The importance of these last two points is not easily overstressed. Industrial development, whether n the development areas and trading estates or elsewhere, the housing programme, a national parks policy, and the reconstruction of the war-damaged towns or transport systems, involve control of the use of land, in order that the national resources may be utilized most effectively. It is not merely that sectional and departmental interests, however important, have to be balanced and adjusted with the other national interests the life of which depends on the same natural resource—the land ; but also any reconstruction programme of food, work and homes must be so devised that the use of land will harmonize with all the main interests—the health and welfare of cities, agriculture, industrial development, transport and communications, food policy, forestry development, and national amenities such as national parks and public access to mountain and sea. But while much progress has been made towards the formulation of a national policy, little has yet been done to forge the instruments for giving effect to such a policy, nor have the vital decisions been taken on the main central difficulty—that of compensation and betterment.

Some of the elements in the situation, it is true, have evidently been defined. The Minister of Town and Country Planning has already announced his intention of introducing during the present session a Bill dealing with compensation and betterment, which it may be hoped will clear the ground for the local planning authorities to exercise far-reaching new powers with courage and constructive wisdom in the execution of the numerous plans already formulated. Simultaneously, Mr. Silkin announced that he was appointing a committee with Lord Reith as chairman "to consider the general questions of the establishment, development, organization and administration that will arise in the promotion of new towns in furtherance of a policy of planned decentralization from congested urban areas ; and in accordance therewith to suggest guiding principles on which such towns should be established and developed as self-contained and balanced communities for work and living". This is an important step, and Mr. Silkin could scarcely have made a better choice for the chairmanship of the committee than Lord Reith.

The new committee will have to examine a wide range of problems, especially if "new towns" includes every kind of 'overspill' community which is intended to be more than a mere contiguous dormitory suburb. Meanwhile, Mr. Silkin will himself discuss with local authority organizations the difficult problem of fitting the new urban growth into the existing structure of local government. The committee itself may have to consider the utilization of some type of agency more flexible than a local authority, and subject to more direct social control than private industry, which can harness the efforts of both in promoting the development of communities in which work and homes, economic needs and community life are properly related ; while Mr. Silkin may find it necessary to acquire the power to forbid further industrial development in over-industrialized areas, deleted from the recent Bill, as well as to ensure that no dereliction on the part of local authorities frustrate the best use of land in the national interest.

The steps taken by Mr. Silkin are only a beginning, but they are something to offset the concern aroused by such cases as the Harlech beaches; and it would appear that technical difficulties are not to prevent a high priority being given to the pledge in the King's Speech to deal with the key problem of compensation and betterment. That is an essential step in achieving the programme of reconstruction to which the Coalition Government was no less committed than the present Government. The Prime Minister has shown in his broadcast speeches and in addressing the Trade Union Congress a clear appreciation of the importance of the Government taking the country into its confidence far more than has been possible during the last six years. The *Planning* broadsheet is a valuable aid in that work of educating public opinion; but no educational work, however vital, can be a substitute for appropriate decision at the centre on the crucial issues and the right priorities.

PROBLEMS OF THE MODERN UNIVERSITY

Redbrick and These Vital Days

By Bruce Truscot. Pp. 216. (London: Faber and Faber, Ltd., 1945.) 10*s*. 6*d*. net.

"REDBRICK and These Vital Days" lacks nothing of the charm and vivacity which characterized "Redbrick University". Once again Mr. Truscot moves with the ease of long familiarity and experience among the problems of the modern university, asking searching questions and suggesting persuasive answers, inspired by a vision of the greatness of the university ideal and by much sound common sense. Here, however, his mordant wit is kept in rather firmer check. He replies indeed with spirit to the criticism of some of the strictures in his earlier book; but the present volume has more coherence and plan. There is less straying into side-issues and irrelevancies, and as a result Mr. Truscot presents us with a survey of the university as a part of the educational system as a whole that none should ignore who are concerned that the community should get the fullest value from that great increase in expenditure on the universities to which we are already committed.

A sense of values and a firm insistence on high standards are indeed the dominant notes of this book. It is a plea for quality as against numbers, for the maintenance of the highest tradition of academic freedom, "to know, to utter, to argue freely according to conscience", and for professional conduct and standards worthy of the university autonomy for which he pleads. His severest criticism and firmest warning are ever against conduct or policies unworthy of the highest traditions of the universities of Britain, or which endanger their independent status as national institutions. He urges a levelling up to the best of Britain's university tradition in freedom, resources, standards and spaciousness. His profound respect for the ideals and achievements of 'Oxbridge' are matched by an unmistakable conviction that 'Redbrick' has the capacity to make its own unique but equally worthy contribution to the service of the Britain, and indeed the world, of to-morrow.

The field over which Mr. Truscot ranges is even wider than in "Redbrick University", and on some of the questions his discussion may seem a little perfunctory. Not all his readers will be convinced without further argument as to the adequacy of his prescriptions even when they accept his diagnosis None can mistake, however, Mr. Truscot's determination to put first things first, and where the solutions he suggests are unacceptable, the onus is on those who reject them to provide an alternative which avoids the dangers of which he gives clear warning

Mr. Truscot deals first with the immediate problems of 'Redbrick University', and in his opening chapter he has a trenchant comment on the implications of the wholesale suppression of the arts courses on which we have in the past been wont to rely for the recruitment of several key professions as well as the administrator, whether in the higher ranks o the Civil Service or elsewhere. The fact that the training of those destined for such careers needs to be improved so that they are aware of the significance of scientific achievements and competent to appreciate the bearing of the scientific factors which enter into the problems they are required to handle, or even that it is desirable that those with a scientific training and administrative ability should be encouraged to follow an administrative career, should not lead us to forget that, as Dr. B. Ifor Evans has reminded us, the last thirty years have given a grim warning of the way in which science and technology in the hands of those devoid of a sense of values, which we derive in the main from the study of arts subjects lead to chaos and barbarism. Mr. Truscot pays a deserved tribute to a broadcast of Prof. V. H Galbraith, but the position could not be better put than in Mr. Truscot's own words, and the passage should not be allowed to escape the notice of the Ministers of Education or of Labour. The number of arts students to be released should be governed primarily by the capacity of the universities to complete their training, and that capacity is believed to exceed considerably the 3,000 students whose release has recently been announced.

In the same chapter, Mr. Truscot argues against a policy of large increases in the number or size o the universities of Britain. If more suitable and efficient entrance tests are applied, he questions whether numbers will rise by more than about 10,000 above their pre-war level, and he stoutly challenges the view that there can be at present anything like 60,000 who are kept out of the universities solely because of the cost. Mr. Truscot may tend to underestimate the post-war demand for science graduate if anything comes of the debate on the expansion o scientific and industrial research; though even so part at least of the demand for technologists would be met by the technical colleges and institutes which he would develop. Fundamentally, he is right to insist on the maintenance of standards and that while no one should be debarred by lack of means no one should be entitled to a university education unless he can profit by it. His estimate that if England had sixteen universities averaging 3,000 student each instead of the present eleven and total of 35,00 students all reasonable needs would be met may no be wide of the mark.

The remainder of this chapter deals with topic discussed more fully in his earlier book, such as th sabbatical year and the need for care in making permanent appointments. He suggests that universities should agree generally to make all post-wa appointments temporary except to positions in xistence before the War began, and on the question f salaries he advances reasoned proposals differing onsiderably from those of the Association of Univer-ity Teachers, particularly in his insistence on the lependence of the reputation of our universities on he quality of their professoriate and on the con-equent need to raise such salaries to scales that vill attract and keep men and women of the highest uality. In defence of such standards, Mr. Truscot s uncompromising and ruthless, and when he returns fresh in a later chapter to the case of the idle pro-essor, the 'wigs are already on the green'.

Mr. Truscot sticks to the suggestions already made nd, as in his former volume, his critique of research s shrewd and sound. This chapter, however, should ot be read apart from the rest of the book. The nsistence on the need for reform here is part of the lea that runs through the whole book for high tandards, for the recognition not merely of new eeds and new responsibilities for the nation in the ost-war world, but also of new obligations too for the niversities themselves, chief among which obliga-ions is that of examining any question afresh in the ght of changed conditions—even of principles con-idered as axiomatic and privileges which by long sage had come to be claimed as rights. He claims hat the universities should help to formulate the ew conception of society by their approach to their wn problems, and that the newer universities in articular must trace out their own way, boldly ut surely, with reference to the wants, real or upposed, of emergent society especially in their egion.

Whether he writes of the reform of the curriculum, he distinction between narrowness and specializa-ion, the content of the honours course, academic epresentation, autonomy and the implications of ncreased assumption of financial responsibility by the tate, Mr. Truscot never loses sight of that high leal, and it inspires all his suggestions. If he looks r no greater increase in the numbers of university tudents, he has no hesitancy in insisting on the need r greatly increased endowment. For residential levelopments he suggests that each of the newer niversities will require a non-recurrent grant of bout one million pounds, with a recurrent annual rant of about half a million for open scholarships, esearch and tutorial posts, travel grants and ther facilities, in addition to the immediate increase f the annual grant to all the universities from the resent two millions to ten millions.

No part of the book is more valuable than the oughtful discussion of the implications of a sub-antial increase in the endowment of universities y the State and of the dangers of State control hich follows; and Mr. Truscot champions the eedom of the universities from State control, from ureaucracy, or from party politics, whether that is xpressed as control of the universities themselves a more insidious tyranny over the academic dividual by the university, as stoutly as he does e need for ample financial provision. Mr. Truscot oks ahead himself, and his outspoken book should least stimulate a real attempt to grapple with me problems of academic freedom, university overnment and inter-university co-ordination where ly hard thinking and foresight can avoid serious fficulties or dangers to-morrow.

When Mr. Truscot attacks internal abuses, it is cause of their threat to the real motive power of e universities. Nowhere is this clearer than in his chapter on the university and its region, part of which has already appeared in *The Political Quarterly*. Mr. Truscot repeats his warning that we should regard with suspicion the demand that the university should continually be thinking of 'society', teaching citizenship, stimulating the social consciousness, supplying experts to local industries and the like. This may well provoke a storm of protest; but Mr. Truscot, who sees as clearly as anyone the guiding and steadying influence to the public mind on great issues which a university in a large city may well be, is right. Unless 'Redbrick' preserves its standards of scholarship, safeguards its intellectual autonomy, establishes the right relation between teaching and research, it can never function as the cultural centre of its region in the way he describes in this chapter.

The university, Mr. Truscot suggests, should be a regional power-house, but it must be sure about the nature and source of its power, and avoid diffusing its energy and indeed its life in beneficent but indiscriminate well-doing. A power-house, not a forcing-house; the monastic, not the crusader's tradition—these are the notes on which he passes to discuss as persuasively the implications first of the Norwood, and then of the McNair and of the Fleming Reports. The Norwood Report, for the most part, he welcomes unreservedly, though he points to the danger of allowing the interview, or school testimony, to rank equally with the written examination in the entrance test to the university. He holds, with the Report, that residence at university age is absolutely essential to an all-round education and must become inseparable from university life. He dissents from the report in its classification of the types of freshman, and suggests that five and not three types are to be distinguished, and that some provision should be made for excluding the 'narrow' candidate from academic life unless of exceptional brilliance. Of the allocation of scholarships and of the influence of the universities on the schools, he writes bluntly and at least lays bare the real issues. Whether his argument is acceptable or not, he writes no less appreciatively and trenchantly of the McNair Report, insisting that the fundamental studies and disciplines of all teachers, primary and secondary alike, are, at their apex, the concern of the universities, and he warmly welcomes the creation of the Foundation for Educational Research.

Finally, in the two chapters in which he discusses the public school problem and the Fleming Report, Mr. Truscot suggests as his own solution of this problem that we should concentrate on the task of raising the standards of day secondary schools to the level of the best public schools: to provide a brilliant or an industrious boy with the best of conditions for his work, tuition by highly qualified and technically skilled masters, contact with minds which will stimulate and enlighten his own, hygienic conditions in which to work, a well-stocked library, playing-fields for recreation, and the education which team games can give. Once again, Mr. Truscot gets down to the essentials, and though these concluding chapters are written from the point of view of the university itself, and the ways and means of ensuring that our universities neither miss any appreciable fraction of those who could profit by a university education nor be cluttered by those who are unable to do so, they will be read with interest and profit by many parents or teachers whether the boys and girls with whom they are concerned are proceeding to a university or not.

R. BRIGHTMAN.

COLOUR FOR ANALYSTS

Colorimetric Analysis

By Noel L. Allport. Pp. xii+452. (London: Chapman and Hall, Ltd., 1945.) 32*s.* net.

ALTHOUGH the author of this book is described—and presumably describes himself—as a "pharmaceutical research chemist", it is clear that only an analytical chemist, in the severest sense of that term, could have produced it. Mr. Allport is, of course, an active analyst and his work is well known and highly appreciated among those who practise analytical chemistry. He has, in fact, produced precisely the kind of book that they would have expected of him—practical, helpful, critical, judicious.

Mr. Allport is obviously not to be reckoned among the old-fashioned chemists who have an acute feeling of misery—and even indeed a marked conviction of sin—if they finish an analytical procedure with anything but a burette or a balance reading. On the other hand, he would certainly have little mercy on the 'colorimetric' enthusiasts who chose to make measurements of colour absorption the end of every analytical procedure, even when methods of greater accuracy or greater ease (or both) are available. But he has selected, under five major headings—metals; acid radicals; substances of clinical and biochemical significance; alkaloids, hormones and vitamins; and miscellaneous substances—a series of colour reactions, all found by himself or known by him to be suitable for application to quantitative purposes with the degree of accuracy required. He warns the user in his general introduction both of the relatively low precision of colorimetric analytical methods, using 'precision' presumably in the American Chemical Society's defined sense of reproducibility, and of their liability to interference "by extraneous substances", which must affect the specificity and therefore the accuracy of the method, using 'accuracy' again in the sense of nearness to correct value.

There are, naturally enough, many well-known methods omitted, but no doubt always for a very good reason. Thus, it is obvious that a method for cholesteryl esters, as distinct from cholesterol itself, is absent because Mr. Allport does not think that there is one good enough to put forward. On the other hand, he has not hesitated to give a colorimetric method for sulphates in blood, where the micro scale of operations makes the classical methods, still to be preferred for most purposes, inferior to the colorimetric, if indeed available at all.

The book gives precise practical details for preparing solutions of which the colour intensity is to be compared with that of a standard, but very wisely confines itself to the description of the chemical analytical procedures involved, and omits the description and advocacy of particular kinds of apparatus, 'colorimeter', absorptiometer, spectroscope, on the correct assumption that they would be out of place in a book of this scope. Indeed, there would be no room to include such matter without making the book unwieldy. It is surely sufficient that Mr. Allport has covered a range of analytical methods for materials ranging from aluminium to vitamin A, from barbiturates to benzoyl peroxide, from vanadium to pilocarpine, from nitrates to saccharin.

The book is admirably produced and written in simple but unambiguous English. One may perhaps doubt whether Mr. Allport, or anyone else, ought to write "much data", but I have not noticed any other hint of solecism. It is, however, worth noting that Mr. Allport, severely practical as always, has take up a position that, if not exactly a Promethean-lik defiance of Zeus's thunderbolts, does at least sugge the cocking of a snook at the Publications Committe of the Society of Public Analysts and Other Analytic Chemists, of which important body he is himself member! For he uses throughout his book the ter *colorimetric* to refer not to "measuring the colour light . . . under certain conditions", stated by th Committee to be the legitimate use, but to processe that are really those of colour comparison or absor tiometry. As Mr. Allport doubtless shares the Con mittee's views that it would be nice to give up th misuse of the term colorimetry, but that it is n possible to do so now, might he not include th scientific definitions of the relevant terms, and th reasons for or against using them, in subseque editions of his book? Whether he does so or no however, those editions will be deserved and welcom

A. L. BACHARACH.

SCIENCE AND PIG-KEEPING

Pigs

Their Breeding, Feeding and Management. By V. Fishwick. Revised edition. Pp. 222+20 plate (London: Crosby Lockwood and Son, Ltd., 1945 12*s.* 6*d.* net.

PIGS in Great Britain are at the moment under cloud owing to their being in competition wit man for cereal foods, their present numbers bein only about 36 per cent the pre-war population. Sin world production and transport of cereals, howeve is likely to increase again before the increased supp of meat from other animals meets the world deficienc in this product, and since pigs breed and matu rapidly, the pig should soon come back into its ow again. The appearance of this book by V. C. Fishwi on the breeding, feeding and management of pigs shoul therefore be particularly opportune; moreover, it is most suitable book for those people back from the Forc who wish to take up pig-keeping on modern lines.

Although based on scientific research and exper ment, the treatment is essentially practical, for th author is himself in charge of an experimental p station and has had to incorporate results of mode scientific research into practical pig husbandry.

There is much also in the book to interest th student of biology; for example, the factors whi influence the growth of suckling pigs are describe how the pigs in a small litter usually take the forwa teats and grow better than those which have t hinder ones in a large litter. The factors which affe anæmia are also dealt with in detail, since this troub is of common occurrence in young pigs. The deta of the qualities required in a high-grade bacon p are described; and results of feeding experimen are given, including rations and systems of feedi adopted during the War with the object of reduci to a minimum the cereals used. Experiments on t effect of feeding on the quality and melting poi of the fat are also referred to, and there is a chapt on the principles of feeding as applied to the pi A chapter on "Policy" includes such topics as indo and outdoor methods of keeping, and division production between the pork and bacon marke Methods of housing and costs are also dealt with.

The book gives a simple account of the ways which science can be applied in pig-keeping.

JOHN HAMMOND.

THE CORROSION OF METALS

THE summer meeting of the London and Home Counties' Branch of the Institute of Physics was held on July 7, in the Physics Department of the Imperial College of Science and Technology, and took the form of a discussion on "The Corrosion of Metals".

In a brief opening address, the chairman, Dr. S. Whitehead (acting-director of the British Electrical and Allied Industries Research Association), gave a broad survey of some of the main aspects of corrosion which, he said, may be regarded as the main disadvantage from which metals suffer when in competition with non-metals for industrial use. Many cases of corrosion of practical importance in industry are electrochemical in character; this type of corrosion can arise as a result not only of contact potential differences between different metals, but also of local variations in ionic concentration where an electrolyte is in contact with a single metal. The long-line corrosion effects observed in buried cables and water-mains are due to short-circuited concentration cells of this type. Electrolytic corrosion may also occur as a result of leakage currents from electrical installations. As a rule, the corrosive effects of A.C. leakage currents are many times less than those of an equivalent D.C. current; but there is some danger that an A.C. current may be partially rectified at joints in the pipe or cable. The practice of electrically bonding adjacent pipes and cables buried in the soil can be beneficial but may be the reverse; in some cases the balance of potential may thereby be so upset as to produce harmful corrosive conditions.

Dr. W. H. J. Vernon (head of Corrosion Section, Chemical Research Laboratory, D.S.I.R.), who discussed controlling factors in atmospheric and immersed corrosion, said that it should be recognized that most common metals are in a metastable condition and that corrosion is merely the transition back to the stable state. In order to prevent and counteract corrosion, it is essential to appreciate the factors governing the reaction. A broad distinction can be made between 'promoting factors' that initiate corrosion and 'controlling factors' that determine its velocity when once begun. In most cases the key to adequate preventive action is to be found in knowledge of the major controlling factor.

Dr. Vernon amplified his remarks with reference to the two main types of corrosive attack by electrolytes, namely, (1) the hydrogen-evolution type, and (2) the oxygen-absorption type. The former occurs in the case of the more electronegative metals when immersed in acid solutions, the cathodic reaction being:

$$2H^+ + 2e \rightarrow 2H \rightarrow H_2.$$

Here, providing there is no falling off in the rate of supply of acid to the metal, the controlling factor is the formation of obstructive films at either electrode. This rarely occurs at the anode; but obstruction to the cathodic reaction often arises as a result of the hydrogen overpotential. As a result, corrosion of this type may be reduced by the avoidance of impurities of low hydrogen overpotential in the metal itself.

Corrosion of the oxygen-absorption type is usually associated with the less electronegative metals and neutral electrolytes, the cathodic reaction being

$$2H^+ + 2e + O \rightarrow H_2O \text{ or, } 2e + O + H_2O \rightarrow 2(OH)^-.$$

In this case there is a much greater chance of the formation of an obstructive film at the anode, that is, of anodic polarization. Very commonly, however, the controlling factor is provided by the rate of access of oxygen to the cathodic parts of the system. Accordingly, corrosion of this type can often be controlled by preventing oxygen access, either by de-aeration or by the use of closed systems of water circulation. Incidentally, as an interesting scientific development, it has been found possible to devise an accelerated method of testing, in which the rate of corrosion is markedly increased by the use of oxygen under pressure.

Turning to atmospheric corrosion, Dr. Vernon pointed out that there are two main types of reaction: (1) metal-liquid reactions, and (2) metal-gas reactions. It is a common error to assume that reactions of the former type are analogous to those pertaining to conditions of complete immersion. This is not so because, although the promoting factors may be the same in both cases, the controlling factors are different. The rate of supply of oxygen, usually the controlling factor for corrosion of the oxygen-absorption type under conditions of complete immersion, no longer controls the metal-liquid reaction in atmospheric corrosion, because in the latter the thin films of moisture in contact with the metal are saturated with oxygen. Consequently, the physical and chemical properties of the corrosion products are generally the controlling factor; in some cases, the rate of supply of water to the surface is decisive.

As an example of metal/gas reactions, Dr. Vernon cited the corrosion of nickel by a dry atmosphere containing sulphur dioxide. In this case the initial reaction is an adsorption of sulphur dioxide at the surface, leading to the formation of sulphuric acid according to the equation:

$$2SO_2 + O_2 + 2H_2O \rightarrow 2H_2SO_4.$$

Whether a metal-liquid reaction or a metal-gas reaction will occur is mainly determined by the humidity of the atmosphere. Probably, for each metal there is a critical humidity, below which corrosion is of the metal-gas type and above which corrosion is of the metal-liquid type. Dr. Vernon illustrated the distinction, and also the effect of suspended solid particles, which is a peculiar feature of the atmospheric corrosion of iron or steel, by means of a series of experimental curves for the corrosion of iron in atmospheres of increasing humidities and of differing degrees of pollution. He concluded with a few remarks on the metal-gas reactions controlling the formation of the primary oxidation films below the critical humidity; the four types of oxidation/time curves so far observed—rectilinear, parabolic, logarithmic and asymptotic—are all amenable to mathematical analysis and can be interpreted in terms of the physical properties of the respective oxide films.

Dr. D. H. Bangham (British Coal Utilisation Research Association) contributed a note on the reaction between copper and oxygen, based on experiments carried out by Bloomer and himself many years ago. This has been concerned with the mechanism of the initial formation of the cuprous oxide film in the oxidation of copper and involved a series of determinations of the rate of oxygen absorption at progressively decreasing temperatures and pressures. At sufficiently high temperatures the oxidation process was found to follow the normal parabolic law, but, as the pressure and temperatures are reduced in successive experiments, the character of the oxidation/time curve changes and a marked induction period is observed. The most interesting fact, however, is that in the case of tests at the lowest temperatures and pressures on cold-worked copper strip, as distinct from the usual specimens, which are annealed, a distinct periodicity in the oxygen absorption has been observed, the pressure within the apparatus oscillating between maximum and minimum values for prolonged periods. To explain the phenomenon it appears necessary to suppose the formation of an unstable mobile copper-oxygen adsorption complex:

$$\text{Cu (strained)} + O_2 \rightarrow [\text{Cu}, O_2] \text{ (mobile)} \rightarrow \text{Cu (unstrained)} + O_2.$$

In these experiments the pressure oscillations did not greatly exceed the reading error of the McLeod gauge; but other cases have more recently come to light where the same basic assumptions are necessary in order to explain first-order effects. Thus Frl. Leipus found that silver mirrors deposited chemically on glass become particulate at relatively low temperatures (implying migration of silver atoms) in the presence of oxygen but not in its absence.

Dr. J. C. Hudson (official investigator to the Corrosion Committee of the Iron and Steel Institute) presented a short paper on the corrosion of iron and steel, with particular reference to the work of the Corrosion Committee. The Corrosion Committee, which was founded in 1928 as a joint research committee of the Iron and Steel Institute and the British Iron and Steel Federation, under the chairmanship of the late Dr. W. H. Hatfield, now includes, in addition to the main committee (chairman, Mr. W. J. Dawson), five sub-committees, dealing with specific aspects of the corrosion problem, as affecting iron and steel. Of these, four, the Atmospheric Corrosion Sub-Committee (chairman, Mr. T. Henry Turner), the Marine Corrosion Sub-Committee (chairman, Prof. J. E. Harris), the Industrial Waters Corrosion Sub-Committee (chairman, Dr. J. W. Jenkin) and the Sub-Committee on the Corrosion of Buried Metals, are concerned with corrosion in the media respectively denoted by their titles. The fifth sub-committee, the Protective Coatings Sub-Committee (chairman, Mr. T. M. Herbert), is engaged on the important task of studying protective coatings and processes for iron and steel exposed to all media alike. In addition, the Committee has conducted considerable fundamental and laboratory research on corrosion, in which respect it enjoys the advantages of close liaison with the important corrosion-research schools at Cambridge and at the Chemical Research Laboratory, with which Dr. U. R. Evans on one hand and Dr. W. H. J. Vernon on the other, are closely associated; reference should also be made to the work of the late Dr. G. D. Bengough in this field.

After a brief description of the experimental procedure adopted in the Committee's researches, in which a special feature is the conduct of tests under actual service conditions wherever possible, Dr. Hudson proceeded to state a few of the main conclusions drawn from the results.

The rate of general corrosion of ordinary mild steel in the open air varies according to the atmospheric pollution and humidity, in conformity with the principles already enunciated by Dr. Vernon in his paper. Where both factors are low, the corrosion-rate is almost negligible; for example, at Khartoum, the rate is about 0·02 mil (thousandths of an inch) per year. Under conditions of high humidity in the tropics, the rate remains slight in the absence of marked industrial pollution, figures of about 0·5 mil/year being observed. In British climates, where the atmospheric humidity and rainfall are conducive to corrosion, the rate of attack is largely conditioned by the atmospheric pollution, with the result that it varies from about 1 mil per year in rural and marine atmospheres to about 4 mils per year in a highly polluted industrial one. These rates of corrosion in the open atmosphere show a tendency to decrease with time; as a rule, no appreciable pitting is observed under normal conditions of outdoor exposure.

When completely immersed in sea-water, mild steel has been found to corrode at rates of 4–5 mils/year, while 1·5 mils/year is a representative figure for the rate of general corrosion of mild steel by clay soils. In these media, however, pitting is an important factor, and the rate of maximum penetration may exceed these figures considerably.

The influence of composition on the corrosion-rate of the ordinary irons and steels produced in large tonnages for structural purposes, as distinct from the highly alloyed rust-resisting steels proper, is most marked in the case of complete exposure in the open air. Under such conditions, ordinary British wrought irons are some 20 per cent less corrodible than ordinary mild steel; they appear to owe this superiority largely to their high slag content, because Swedish wrought iron, which is prepared from high-grade ores smelted with charcoal and is of high purity, is up to 50 per cent more corrodible than mild steel under the same conditions. Moreover, ingot iron, a dead mild steel with the lowest practicable carbon content, shows no superiority to ordinary mild steel under these conditions.

The addition of small percentages of alloying elements to mild steel or wrought iron produces an appreciable improvement in corrosion resistance. In the open atmosphere, a steel containing 0·2–0·5 per cent copper loses approximately 20 per cent less weight than one containing no copper. The joint addition of 0·5 per cent copper and 1·0 per cent chromium produces a greater improvement, and doubles or trebles the corrosion resistance of the steel.

Dr. Hudson then gave a short account of the work of the Protective Coatings Sub-Committee. The most important protective coatings for iron and steel fall into two main groups: (1) paints, (2) metallic coatings. The earlier work of this Sub-Committee was devoted to a study of protection by means of paints, with special reference to the effect of the surface preparation of the iron or steel prior to painting. The results were summarized in a brochure entitled "The Protective Painting of Structural Steel" published by the Iron and Steel Institute. The main conclusions to be drawn from this work are that (1) the best results can only be obtained when paint is applied over properly prepared surfaces from which all rust and mill-scale have been removed; this is best accomplished by pickling or shotblasting; and (2) in many circumstances, particularly where paint is applied to a weathered and wire-brushed surface, it is important to use an inhibitive primer, such as one containing red lead.

The Protective Coatings Sub-Committee is now extending its studies of protective painting to include the formulation of the paints themselves. This work is being conducted in collaboration with the National Federation of Associated Paint, Colour and Varnish Manufacturers of the United Kingdom; technical details of the programme are in the hands of a joint technical panel under the chairmanship of Mr. F. Fancutt, consisting of three representatives of the Sub-Committee and three representatives of the Federation. The first series of tests arranged by this Panel will be concerned with priming paints for heavy structural steelwork, and is about to commence.

The use of metallic coatings for the protection of iron and steel against corrosion has increased considerably in recent years, because a larger number of metals and alloys has become available for the purpose, owing to developments in the means by which it is possible to apply them; for example, zinc can now be applied by cementation (a diffusion process in the hot state), electrodeposition, hot-dipping, or spraying. Accordingly, the Protective Coatings Sub-Committee decided in 1940 to undertake a systematic investigation of the behaviour of protective metallic coatings as applied to mild steel when exposed both to atmospheric and to marine conditions. Coatings of five metals, aluminium, cadmium, zinc, lead and tin and of two alloys, 82/18 cadmium-zinc and 88/12 lead-tin ('terne'), are included in the tests, and a report on the results of observations during the first four years exposure will be published shortly.

The work of the Marine Corrosion Sub-Committee has included an investigation of formulated anti-corrosive paints for the protection of iron and steel under conditions of complete immersion in sea-water; paints in a modified phenolformaldehyde/stand oil medium, pigmented with basic lead sulphate, in admixture with white lead, aluminium and other pigments, have been found particularly suitable for this purpose. The study of marine corrosion is indissolubly connected with that of fouling, and the Sub-Committee has a team of investigators working in this field also, at first under Dr. (now Prof.) J. E. Harris and at present under Mr. K. A. Pyefinch, in the laboratories of the Scottish Marine Biological Association, Millport.

Mr. P. T. Gilbert (British Non-Ferrous Metals Research Association) discussed various aspects of electrochemical measurements in corrosion studies and described in detail a multiple-recording apparatus which he has devised in collaboration with Mr. A. B. Winterbottom to record the variation with time of the electrode potential of corroding metal couples. This apparatus can be used for simultaneous tests on four complete couples and takes twenty-one individual records per cycle, including the potential differences between each member of each couple and a reference electrode, the corrosion current in each cell, together with various necessary subsidiary measurements of temperature, etc. The recording apparatus is a Cambridge thread recorder, dotting every ½ min., so that each individual reading is repeated at intervals of 10½ min.; the selection and sequence of the readings is controlled by a Post Office selector switch.

Mr. Gilbert discussed a number of general points relating to the design of apparatus of this type. The choice of reference electrode is important; the conditions of use in this case are rather severe for the usual types of reference electrode, and in addition it is desirable to avoid any possible contamination of the corrosive solution. The silver/silver chloride electrode fulfils these conditions most satisfactorily; it retains a constant potential provided that the chloride ion concentration in the solution does not vary. The choice of apparatus for the actual potential measurements is governed by the desirability that it should involve tapping the minimum current possible from the cell so as to avoid interference with the course of corrosion. This has been accomplished by using an electrometer valve circuit, which takes a negligible current of the order of 10^{-15} amp.

The supply of a stable voltage to the valve potentiometer over the fairly long periods covered by the experiments caused trouble at first, when the investigators relied on a 10-volt battery, so they constructed a circuit for ensuring a relatively constant voltage from a mains supply. Accurate measurement of the corrosion current may also present difficulties, owing to the complication introduced by the resistance of the ammeter needed to measure it; Mr. Gilbert described two methods of eliminating this factor.

The apparatus has been applied to a study of the variation in the electrode potentials of zinc and iron, when immersed in tap-water in increasing temperatures up to 85° C., the atmosphere over the solution being varied so as to include various mixtures of oxygen, nitrogen and carbon dioxide. The results have not yet been published, but information of the greatest interest has been obtained on the conditions under which in hot water, zinc becomes more noble as the temperature of the water rises and iron less so, with the result that the potential difference between these two metals becomes reversed. Obviously, this has an important practical bearing on the use of zinc coatings for the protection of steel parts used in hot-water systems, as it represents a complete reversal of the normal state of affairs in which galvanized coatings protect the iron or steel to which they are applied by sacrificial electrolytic action. In view of its importance, the matter is being investigated further.

In the last paper, Dr. W. G. Radley (controller of research, Post Office Engineering Department) described some practical instances of corrosion in telecommunication plant. The prevention of corrosion is an important problem to the Post Office, two typical sources of trouble being (1) the corrosion of the lead sheathing of buried cables, and (2) the corrosion of wires in telephone exchanges.

Dr. Radley said that, although all underground cables are laid in conduits, this does not eliminate corrosion, because no conduit is water-tight and the ground-water percolates in. Corrosion of the lead sheathing is of two main types, stray-current electrolysis and direct attack by ground-water. The solution of problems of stray-current electrolysis depends on tracing the leakage currents responsible for it to their source. Methods of determining stray currents by means of earth electrodes, such as that of Schlumberger, are not readily applicable to cables enclosed in a conduit, and the Post Office relies on simultaneous measurement of the current in the sheath at two points a short distance apart. For this purpose a highly sensitive but robust galvanometer is used, by means of which continuous readings of the stray currents can be recorded photographically. More recently, the possibility has been explored of making direct measurements of potential differences along the sheath by means of non-polarizable electrodes.

Chemical analysis and microscopic inspection of the corroded sheaths often give a clue to the nature of the corrosion; for example, in the absence of any abnormal concentration of chlorine ions in the soil water itself, it can generally be concluded that the presence of 5 per cent or more chlorine in the corrosion product is an indication of corrosion of the stray current type.

Attempts to reduce the attack by the substitution of certain lead alloys for pure lead have not so far resulted in any decisive improvement and, although the use of other materials such as thermoplastic synthetic resins has been suggested, no satisfactory substitute for lead sheathing has been found. Laboratory tests show that the addition of silicates, phosphates, chromates, tungstates and molybdates reduce the plumbo-solvency of ground-waters, and since 1931, attempts have been made to make practical use of this fact by the incorporation of sodium silicate in the petroleum jelly used as a lubricant on cables. As a result, in localities where corrosion is mainly chemical, there has been a considerable increase in cable life.

As regards the corrosion of wires in telephone exchanges, Dr. Radley mentioned instances in which extensive failure occurred in unattended rural exchanges within a period of ten years. It is difficult to propound a theory accounting adequately for this corrosion, but humidity, the presence of electrolytes in the insulating wrappings, and potential differences between wires that are touching are contributory factors. Variations of atmospheric humidity are inevitable in exchanges of this type despite air conditioning, and under certain conditions condensation of moisture may occur on parts of the apparatus. Electrolytes are present in all cotton wrappings, but it has been found that they can be eliminated to some extent by washing the wrappings. The practical value of this process is under investigation. Cellulose acetate and acetylated cotton have a lower ash content than cotton and are used as the inner wrappings in place of natural silk.

In the course of the ensuing discussion Mr. J. S. Forrest gave some examples of corrosion of overhead power lines, Mr. Clarke discussed the effect of oxygen in solution on the rate of corrosion, and Mr. A. B. Winterbottom made a mainly mathematical contribution on the use of an optical method for the study of film formation.

SEX EDUCATION: AIMS, POSSIBILITIES AND PLANS*

By CYRIL BIBBY

We come now to what many people will regard as the crux of the matter—when the appropriate facts have been encouraged, what may we expect to be the outcome in terms of sexual behaviour? What, indeed, do we *wish* to be the outcome?

We have to recognize that in Great Britain to-day there is a wide divergence of opinion on questions of sex morality, and in particular, on the question of pre-marital intercourse. For those of our fellows who accept the Church's teaching in its entirety, no queries will arise about the validity of the marriage institution. But increasingly young people are demanding some other justification for it, and those concerned with sex education must either find the justification or honestly admit that they know of none. I believe, however, that the search is not a very difficult one.

Those who see no intrinsic evil in sex may well feel that in a new Utopia the institution of marriage would have no place, that sex relations would be so governed by universal harmony that any contractual basis for living together would be quite unnecessary. But we are not living in a Utopia of perfect beings, and most of us, I imagine, feel that in our present society the married state has a good deal to be said for it.

I believe, however, that a disservice is done to the cause of sexual morality by those who fail to recognize any gradation in standards of behaviour, and lump together all types of pre-marital intercourse under the omnibus title of 'fornication'. I feel some impatience, moreover, with those who seek by their statements to convey the impression that young people to-day, in contrast with the virtuous youth of their own generation, are sunk in sexual vice. It might restore them to a sense of perspective were they to read the words of Alcuin of York, written before ever William of Normandy set foot on these shores. "Since the time of King Aelfwold . . ." he wrote, "the land has been absolutely submerged under a flood of fornication, adultery and incest, so that the very semblance of modesty is entirely absent." Substitute the name of any recent monarch, and there is the gist of many a modern lamentation.

Fulmination, I feel, is a good deal less effective with young people than reasoned argument. It is my experience that the much maligned youth of to-day *will* pay some attention to the views of a sympathetic adult who seeks to persuade them that not all conventions of sex behaviour are hypocritical and not all restraints puritanical. Let us not delude ourselves, however, that even with the most reasoned arguments in the world, all pre-marital sex relations would disappear. No amount of mere talk will of itself dam up the sexual urge of lusty youth. Far-reaching social changes are needed too, and among them is the removal of the all-too-many barriers to early marriage. Equally important is the need to give young people the feeling that they have some future and that there is something for which it is worth while to postpone their sexual satisfaction; to assure them that there is something that they can give to society and which will give them an honoured place in it, to inspire in them some burning sense of constructive social purpose.

One last word about my suggested definition of aims. I stated that sex behaviour should be according to a rationally determined code, but I do not prophesy what that code will be. It would be possible for us so to condition each new generation that it almost automatically thought and felt as its rulers desired: experiment along these lines achieved some considerable degree of success during the last twelve years in Nazi Germany. But, for me at any rate, no such reflex subservience to an authoritarian moral code is included in the aims of sex education. I am content to teach the facts as well as may be, to encourage an open and healthy attitude to sex, to insist on the need for determining conduct rationally —and to have faith that a generation so educated will be at least capable of taking correct moral decisions and making correct moral judgments.

When we leave the definition of aims and begin to draw up definite plans for action, there are, it seems to me, several dangers that must be avoided.

The first is that of Utopianism. There is a great temptation in sex education, as indeed in education generally, to draw up magnificent schemes that are totally irrelevant to the particular social setting within which they are to be put into practice. Let our plans, therefore, be impregnated through and through by an appreciation of what is possible and desirable here and now, not what might be in a brave new world.

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* Continued from page 414.

The second danger is that of wasting energy on barren argument about whose job sex education is. For too long parents and teachers and medical practitioners have been, to use an Americanism, 'passing the buck' to each other. Sterile disputation about the precise allocation of degrees of responsibility must give way to serious preparation for getting on with the job in hand and to close collaboration between all who have any part to play.

Another danger is that of over-emphasizing sex and isolating it from the rest of life. To this danger some of the early pioneers fell prey. The perhaps inevitable result of their determination to bring sex into its place in the educational picture was that they painted a canvas on which it loomed over-large. In their rightful insistence that children should not remain in ignorance, they tended sometimes to overload them with information beyond the bounds of their curiosity, intellectual ability or emotional understanding. This tendency must be avoided. Sex education, like health education and character training generally, should permeate the whole of life. The better it is, the less obvious it will be. It will just fit in naturally and inconspicuously into the ordinary life of home, school and community, and will be noticeable only to the degree to which it is imperfect.

Never has the mental atmosphere of the country been so favourable to sex education as now, and now is the time to crystallize support. Talks to public meetings, men's and women's guilds, educational and other discussion groups, and so on, should be arranged in each area. Radio talks, film shorts, posters, newspaper advertisements, etc., can be used to a similar end on a national scale. If this were done with energy and determination, I believe that all opposition to sex education, except that of the confirmed obscurantists, could be overcome within a very short period.

There is another immediate problem that needs mentioning. While we are perfecting our long-term plans and awaiting their fruition, our schools send out into the world each year vast numbers of children who have had no sort of reliable sex education. We cannot afford to be perfectionists and do nothing because we cannot do the best. As a temporary measure, therefore, talks on sex should be arranged in youth clubs and the like, and specially devised lessons given in the schools. But the sooner we get rid of this patchwork procedure, the better.

We must concentrate a good deal of attention on the education of the educators, so that a continuous scheme of sex education may be put into practice at the earliest possible moment. Long-term plans must nclude drastic alteration in school, university and raining college curricula—but we cannot wait for hat. Side by side with these changes must go the rganization of immediate help to present parents, eachers, youth leaders, medical men, nurses and eligious and social workers. What can be done to give such help?

I would agree with Charles Dickens when he wrote: 'We thought that, perhaps, it is right to begin with he obligations of home, sir; and that, perhaps, while hose are overlooked and neglected, no other duties an possibly be substituted for them", and shall herefore consider parents first. Rosy optimism is worse than useless, and it must be recognized that many present parents are too ignorant to explain the acts of sex to their children, too indolent to remedy heir ignorance, and too tangled in their emotional attitudes to be able to do much were they very encyclopædias of sexual knowledge. But not all present parents. Many are well informed and many others anxious to inform themselves. Many have a thoroughly healthy attitude to sex and many others are eager to attain it. With such there are great possibilities. Courses could be arranged for the parents of new entrants to the nursery or infant school, and perhaps again when their children pass on to the secondary stage. More systematic help and guidance could be given to expectant and nursing mothers at the clinics and welfare centres. The matter could be dealt with at village institutes, community centres, co-operative guilds and the like.

So far as teachers are concerned, it is reasonable to expect a much more thorough preparation. Most of what is needed to provide the necessary background to sex education should indeed be part of the normal professional training course. All teachers need an understanding of the child's bodily, intellectual and emotional development, and this can only be based on a knowledge of fundamental physiological and psychological principles. It would also be very valuable for teachers to have an understanding of the sexual behaviour and problems characteristic of children of various ages, and to study in more detail those of the age-range which they are specially preparing to teach. Moreover, since sex education in the school will be effective in proportion as sex education in the home is not neglected, teachers need also to understand something of the problems of home life and infant training. All teachers need also to be equipped with certain fundamental data which will enable them to answer adequately questions which happen to arise in their school lessons. This implies that all teachers in training—whether they are going to teach the functioning of living things or the structure of dead languages—should take a course in human and social biology. Some training is needed also in the technique of sex education. The ways in which the various subjects of the school curriculum may be utilized as media of sex instruction, the value of various extra-curricular activities in the development of character, the effect of the general school routine and tone upon the fixing of sex habits and attitudes—all these should be studied. Specialist teachers, such as biologists, will naturally need a still fuller preparation.

If it be objected that there is no time to study all this, so much the worse for the very inadequate period of training which is still considered sufficient for teachers.

In the future we may have such teachers, but there are few to-day. In the meantime, then, what can be done? Most present teachers of biology have the background which will enable them to pick up the necessary extra factual knowledge quite quickly, and many of them have the requisite personality. What is most needed in such cases is courses of instruction by specialists, dealing in part with those physiological and psychological aspects of sex which are not normally covered in university and training college syllabuses, and in part with the technique of sex instruction in the school. Such courses will not make first-rate sex educationists of all who attend them, but at any rate some of the teachers will then be competent to deal with the subject with their pupils, and the others will at least have some understanding of what is aimed at.

Now what of youth leaders? It is encouraging to note that the 1944 McNair Report comments that:

"There are three matters which are of great significance for young people—religion, politics and sex. They are certain to arise, sooner or later, in any discussions with boys and girls on social conditions or their own physical, mental or spiritual problems. Leaders must therefore be prepared to face them." When the county colleges envisaged in the new Education Act become a reality, they will presumably provide a useful channel for guidance in these matters. In the immediate future, we shall have to do the best we can under the present very difficult conditions of inadequately trained youth leaders, poor club accommodation and so on. The difficulty is, moreover, accentuated by the fact that most of the club members will have received little or no sex education in earlier years. Apart, therefore, from definite lectures to the young people themselves, such as were suggested earlier, the main advance must be that of giving a general background of knowledge to youth leaders, which will help them to deal more effectively with the problems of behaviour which always arise in youth work and to give helpful personal guidance to their club members.

We must recognize, however, that most young people spend only a few hours each week in their youth organization and the major part of their day-time at work. Parallel with what is done in the club, therefore, it seems essential to tackle also the environment in factory, shop and office. The co-operation of industrial welfare workers and of shop stewards and trade union officials should, therefore, be enlisted in any balanced programme of sex education work.

Now let us consider the medical profession. What part has it to play in sex education? The quite common opinion that medical men are peculiarly qualified to give sex instruction is, I suspect, an aftermath of the feeling that sex is in some way abnormal, and therefore to be handled only by medically qualified persons. This idea, I hope, is dying out rapidly and the role of the medical practitioner should be estimated without prejudice.

Any other than elementary instruction on the venereal diseases is clearly the medical man's province, as are other problems of sexual pathology; while a great deal of work in preparation for marriage, concerning the technique of intercourse, the practice of contraception and so on, is largely medical in nature. Medical practitioners also, particularly those specially concerned with the young child, should be able to give much helpful advice to parents.

But those medical practitioners who aspire to be sex educators will need to give careful study to the psychological aspects of sex as well as to its physiology; and they will need sociological insight too. Sex relations and marriage are not purely medical problems. Equally they are problems of politics and economics, of passion and of friendship, of intellectual companionship and mutual respect. Is it too much to hope that medical training might in the future pay more attention to these and other related matters? No doubt, as in the training of teachers, there is the difficulty of already overcrowded syllabuses. But would not some little study along these lines be of more value to the general practitioner and his patients than a painfully acquired familiarity with the fine details of human anatomy?

Other health workers, too, have a part to play. Particularly in rural areas, the district nurse and health visitors could do much to bring about a more enlightened attitude to sex among the parents with whom they come into contact. But to be really helpful to the mothers they meet, they will in most cases need further preparation themselves. Having already a good background knowledge, it should be fairly easy for them to extend their understanding. In the future this extra field should be part of their training; for the present, special short courses should be arranged.

The question now arises: Suppose that all these different categories of people *do* attend special courses of instruction—will that guarantee their suitability to play a part in sex education? The answer, I suggest, is quite clearly 'No'. He who would undertake sex education with success needs many qualities which may bear little or no relation to special training or academic attainment. The first essential is personal sex adjustment and an absence equally of prudish disinclination to discuss sex and prurient tendency to discuss it to excess. In all education the teacher needs a sympathetic understanding of the pupils, but this applies with special force in sex education. Hypocrisy and narrow-mindedness are fatal. Honesty and tolerance are essential. Imagination is needed too—the ability to sympathize with the feelings of a child and to understand the perplexity of the adolescent, while yet retaining the mature judgment and emotional stability of the adult. One other quality I would add—that of a sense of humour. I know no solvent of strain more effective than laughter, and the person who cannot throw in a joke now and then has no place in sex education.

This is both a warning and an encouragement. It is a warning against judging people's suitability for sex education by their paper qualifications, and an encouragement to those thousands of good-hearted but modest folk in the street who wish to help in sex education but have been doubtful of their ability to do so.

It is now generally agreed that sex education should not be considered as an isolated subject; and its integration with the rest of education, it seems to me, has two main aspects. One aspect is that of sex education as part of health education generally, and the other is that of sex education as part of a wider education for family life.

There, surely, is a worthwhile task in which many organizations could play an important part. Could not sex education grow into something much wider and richer if really close collaboration and coordination were achieved between all the bodies doing sex education work, the moral and socia welfare organizations, those concerned with marriage guidance and family planning, organizations dealing with heredity, eugenics and population problems those working in the field of maternal and child welfare, and so on? This is obviously a matter requiring close and critical consideration by all the organizations concerned, and I commend the suggestion to their attention.

Among other matters which are simply crying out for attention is that of research. A very considerable volume of sex education work is being carried out—and, I venture to think, with some success. But w cannot close our eyes to the fact that it is all bein done quite empirically. We have our ideas about th amount and degree of accuracy of the sex knowledge of the people we are trying to educate; but we hav no exact knowledge. We have general impression of what their attitudes to sex and sex behaviour ar —but we have no exact knowledge. We make estimates of the relative efficacies of the various technique of sex education—but again we have no exact know ledge. The securing of this exact knowledge should be high up on our list of priorities. Just how it should be carried out I am not competent to say—that would need the combined intelligence and experience of educationists, medical practitioners, psychologists, social workers, statisticians and field research workers.

People's attitudes to sex, like their attitudes to any other aspect of human life, do not crystallize in isolation, but are shaped and impregnated by the views of their fellow-citizens and by the whole structure of the society in which they live. That is why some enthusiasts for sex education live in a fool's paradise. Imagining that it is possible in a few lectures to overcome the influence of years of living in a society with distorted views of sex, they are due for disillusion. The best results will follow from sex education only when the whole of our society is remodelled, and our children grow up from the earliest days surrounded by adults who feel that sex is an excellent and joyous thing in which man and woman join as equal partners, sharing benefits and responsibilities alike. Meanwhile, our scheme of sex education must not be drawn up *in vacuo*, as if sex attitudes and sex behaviour were things fixed and immutable. If it is to be really potent, it must be sex education for our particular social setting.

FAMILY FOOD CONSUMPTION IN THE UNITED STATES*

A VALUABLE report has been issued* giving a detailed account of the analysis of data obtained in the United States during a large-scale inquiry into family spending and saving, of which food consumption returns formed a part. It also includes a useful discussion of the various techniques which can be employed in collecting data and the way in which choice of method may affect the picture given by the returns.

Since the United Nations Conference on Food and Agriculture focused attention on the responsibility of a government for the standard of nutrition in the area under its control, reports which describe in detail the way in which different countries conduct dietary surveys in their own territories should find a ready welcome.

The first essential is a basic stock-taking in order to obtain an over-all picture of the food resources of the territory and the nutritional requirements of the community. This provides the background against which more detailed surveys can be tested and on which plans for betterment can be based. There are, however, many territories for which such a simple balance sheet cannot yet be prepared, because the necessary basic data are not available. Imports and exports are usually known with considerable accuracy, but acreage under food crops and the yields normally obtained are not. In some areas there is no information regarding the total number of people forming the community, far less any details of the population distribution in terms of age, sex, and occupation. Without such information nutritional work can at best be only a patchy process, and is apt to be confined to the few more fortunate individuals who happen to come under observation.

A satisfactory balance sheet does not in itself ensure that all is well. It assumes that food is being distributed according to need, and that is a thing which rarely happens. For this reason continual surveys are required in order to provide information about distribution and the factors which determine it. There is no simple way of obtaining this information, and all the methods so far employed have decided limitations. Clearly the smaller the unit that is observed, the greater the number of records which must be kept if the results are to be used as an indication of trends in the community as a whole. Yet if the unit consists of more than one individual, the possibility of maldistribution still exists.

Usually the family has been chosen as the unit for observation. Maldistribution of food may (and often does) occur inside the family; but it nevertheless represents a compact catering unit, and the individuals composing it are on the whole subject to the same controlling influences.

The present study has taken the family as the unit and it claims to represent "the entire civilian housekeeping population of the United States". The distribution inside the sample is said to check very well with census data, but all breakdowns are given in percentages, and the actual size of the sample does not appear to be stated. It would, however, have been possible to handle a very large number of budgets as no direct measurements were undertaken.

In the United Kingdom, the Ministry of Food has run a continuous "War-time Food Survey" in which the investigators have visited the families and supervised all weighings and record-keeping. Since one investigator cannot cover more than ten families at a time (visiting on alternate days during the survey week) the number of records that can be collected is limited by the number of investigators available. It is, however, a method which involves direct measurement and it also affords an opportunity of assessing the relative effects of other influencing factors.

In contrast to this, the present inquiry was conducted as follows :

"Each housekeeping consumer unit interviewed was requested to give detailed food information for the previous week as well as the information on income and expenditure for all goods and services for the calendar year 1941 and for the first quarter of 1942."

A food schedule was provided listing 177 food items, and the information sought was (*a*) food bought during the preceding seven days—quantity and price ; and (*b*) food eaten during the preceding seven days—quantity (specifying whether home-produced, bought, or other), and price. Among additional information required was "the number of meals furnished from home food supplies in the seven days covered by the food schedule for each family member, boarder, guest, or paid helper in the household".

The chief criticism against conducting an inquiry in this way is that it is too much in the nature of a memory test, and is therefore subject to all the frailties of that human mental process. The authors are not unaware of this weakness ; they themselves say :

"The method used in this study to obtain food consumption data is, of course, subject to some error. It is not expected that the homemaker can recall with great precision the exact quantities of each of the kinds of food consumed. There may be some understatement and some overstatement that is not compensated for within a single schedule. However, it is believed that in the averages for fairly large groups of families these are compensating errors, particularly for items consumed by most families."

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* Family Food Consumption in the United States. (U.S. Department of Agriculture, Miscellaneous Publication No. 550.) Pp. vi+157. (Washington : U.S. Government Printing Office, 1944.) 20 cents.

The interpretation of the data, however, turns so much on this assumption that the errors are compensating ones that it would seem well worth while to organize a survey specially to test the truth of it. A memory test for impersonal facts might be expected to produce compensating errors; but food consumption is so closely linked with community culture and with individual likes and dislikes that the memory picture of food consumed must surely be subject to such influences and therefore liable to uncompensated errors. At present the justifiability of the assumption remains a matter of opinion.

The other major factor limiting the usefulness of this survey is the fact that it covers one season of the year only. The influence of this factor is, however, given due consideration in the discussion relating to each group of foodstuffs in turn.

On the sociological side the returns are grouped according to (1) urban, (2) rural non-farm, and (3) rural farm families, and then further subdivided according to income class. Differences were found, and these differences (in the records) are real, whatever the causes of them may be. As usual, improvement in dietary went up with improvement in income-level inside each main group and, as might have been expected, the biggest differences in the 'consumption patterns' were between the farm families and the urban ones. The rural non-farm families occupied an intermediate position. The authors point out that:

"Farm families had a better opportunity than non-farm families to maintain and improve upon their usual levels of food consumption in the face of rising food costs, food shortages, and reduction in the variety of foods offered for sale because such a large share of their total food supply was obtained from the farm."

It was found that 90 per cent of the milk, 95 per cent of the eggs, 60 per cent of the meat, poultry, fish, fats and oils, 25 per cent of the sugars and sweets, and 20 per cent of the grain products consumed by farm families were produced by themselves.

In terms of nutrients, the farm families' dietaries were superior to the urban ones in calcium, protein, riboflavin and iron, equal in thiamin and vitamin A, and inferior in niacin and ascorbic acid.

The intermediate position of the rural non-farm families is considered to reflect "the ability of many of these families to produce part of their food supply at home and to buy some farm products at lower prices than families in cities", in addition to the fact that they tended to be also of intermediate standing with regard to income.

To other survey workers possibly the most interesting part of the report will be Appendix B, dealing with the methodology. Family consumption records are always complicated by meals taken out and by odd meals given to visitors. The authors point out that "the size of family from the point of view of food consumption is not merely a count of persons, but a count of meals consumed by the persons in the family". For this reason they took the total number of meals served during the week, divided by 21, and called the resulting figure "size of family". 21 was used for the divisor because it was the usual number of meals served to each person each week. Meals taken away from home were not counted. This method of breakdown ignores age, sex and activity, and results obtained by it can only be used for comparative purposes if the communities surveyed are of similar composition. In this case the non-farm groups contained fewer children and men, and the physical activity of the adults was less than in the farm groups.

Requirements were assessed in detail in terms of "equivalent nutrition units". This is a modern variation of the old man-value computation. The use of man-value scales fell into disrepute because they were based on calorie needs only, and disregarded the fact that the requirements for other nutrients do not run parallel. Relative units can, however, be quickly calculated for any set of recommended allowances. In this study "the scales of relatives have been derived from the daily allowances for calories and the specific nutrients recommended by the Food and Nutrition Board of the National Research Council, May 1941. The dietary needs of the moderately active man were considered equal to one nutrition unit; the needs of the other sex-age-activity groups are expressed in relation to those of the moderately active man". Thus a girl of 13–15 years of age counts as 0·93 of a man unit for calories, 1·62 for calcium, 0·74 for riboflavin, and so on.

An alternative method of assessment is that which finds the requirements of the community by adding together the requirements of each sub-group and then divides the resultant totals by the total number of persons. This gives weighted requirements *per capita* and was the method used in the report, "Food Consumption Levels in the United States, Canada, and the United Kingdom".

In the present report, the data have been arranged and re-arranged in many different ways (there are forty-five very detailed tables), and in fairness it must be said that the authors do seem to have directed attention to all possible sources of error and to the limitations imposed by the methods they adopted. This is an attitude of mind that should be encouraged.

M. W. GRANT.

OBITUARIES

Mr. E. Lancaster-Jones

THE death occurred on September 9 after a short illness of Ernest Lancaster-Jones, keeper of the Science Library. He was born at Radcliffe on November 8, 1891, and was educated at Bury Grammar School. Later, with a mathematical scholarship, he proceeded to Christ's College, Cambridge, and graduated in 1914.

In 1915 he was commissioned in the East Lancashire Regiment, transferring in the following year to the Royal Engineers, with which corps he served for three years in Greece, Macedonia and Egypt. In 1916 he married Geraldine Hilda Anne Farnham, of Burnham-on-Sea, who died in 1942.

In 1920 Lancaster-Jones was appointed assistant at the Science Museum, where he performed valuable work assembling and developing the collections of acoustical and electrical instruments, on geodesy and surveying, and was responsible for the Museum handbook on the geodesy and surveying collections, which appeared in 1925. The introduction from Budapest to Britain in 1920 of the first Eötvos torsion balance provided a unique opportunity for studying the gravitational method of applied geophysics, and Lancaster-Jones devoted himself wholeheartedly to the development of this subject. Frequently, investigations could only be made during the night, and often under very difficult and trying weather conditions, but his determination and outstanding ability enabled him to devise new methods and instruments, and he soon acquired an international reputation.

Lancaster-Jones was transferred to the Science Library, where he was appointed keeper in 1938. He was largely responsible for the rapid development of the Library, enabling it to contribute so effectively owards the scientific war effort of the country. He possessed a wide knowledge of scientific literature, coupled with a natural organizing ability and an unusual capacity for work. During recent years he found additional interest in the activities of the Association of Special Libraries and Information Bureaux, and played a major part in the introduction of microfilm methods into Great Britain.

'L. J.', as he was affectionately called, was greatly espected by all who knew him. A man free of all conceit and pretences, he was completely sincere and unassuming. He was a deep thinker and a hrewd judge of human character, and successfully combined firmness and discipline with ease and friendliness. His love of various kinds of sport was nly equalled by his fondness for children. Early last year he married Eleanor Joyce Chapman of London, and with her and his son and daughter we mourn the loss of a sincere and valued friend who had so endeared himself to us.

H. SHAW.

WE regret to announce the following deaths:

Prof. W. B. Cannon, C.B., For.Mem.R.S., emeritus professor of physiology in Harvard Medical School, on October 2, aged seventy-three.

Prof. Roscoe G. Dickinson, professor of chemistry at the California Institute of Technology, known for his work on the X-ray analysis of crystals, photochemistry and reaction kinetics, on July 13, aged fifty-one.

Sir David Milne-Watson, Bart., recently governor of the Gas Light and Coke Company, on October 3, aged seventy-six.

Dr. J. C. Mottram, director of the Research Laboratory, Mount Vernon Hospital, Northwood, Middlesex, on October 4, aged sixty-five.

Mr. H. M. Pendlebury, of the Museums Department, Kuala Lumpur, on September 22, from the effects of three and a half years' captivity in Japanese hands.

Prof. J. Strong, O.B.E., emeritus professor of education in the University of Leeds, on October 7, aged seventy-seven.

NEWS and VIEWS

Prof. G. B. Jeffery, F.R.S.

DR. GEORGE BARKER JEFFERY, the new director of the Institute of Education, University of London, was associated with University College, London, from 1909 onwards, as an undergraduate, a lecturer in the Department of Applied Mathematics, and for twenty-one years as Astor professor and head f the Department of Pure Mathematics. He broke the continuity of this long service with a year t the London Day Training College (now the Institute of Education) and two years as professor of mathematics at King's College, London. His many aluable contributions to mathematical journals deal mainly with the applications of pure mathematics to hysical problems, in particular Einstein's relativity theory. As Astor professor he set himself to evelop a school of pure mathematics in London and took a leading part in the activities of the London Mathematical Society. He has figured prominently in the affairs of University College. As pro-provost of the section of the College in evacuation at Bangor, his diplomacy at the outset paved the way for a happy co-operation. Taking a keen interest in student life, he laboured to preserve the traditions of the College and to weld the students into a cororate whole. On returning to London in 1944, he took the lead in instituting student hostels. A member of the Senate of the University of London, he has taken a wide interest in educational problems, the schools as chairman of the Matriculation and Schools Examinations Council, in the University as member of the Academic and External Councils and as dean of the Faculty of Science. He has ways urged the claims of women to equal educational opportunities, especially in the London medical hools. His flair for clear thinking has steered many fficult matters through University channels.

Astor Chair of Mathematics, University of London: Prof. H. Davenport, F.R.S.

PROF. HAROLD DAVENPORT has been appointed to the Astor chair of mathematics in the University of London in succession to Prof. G. B. Jeffery and is beginning his duties at University College this session. He comes from Accrington Grammar School, the University of Manchester and Trinity College, Cambridge, of which he was formerly a fellow. He is a fellow of the Royal Society and was recently professor of mathematics in the University College of North Wales, Bangor. He has established his position as one of the most distinguished of the younger English mathematicians. His researches have been specially in the field of the analytic theory of numbers in the tradition of Hardy and Littlewood, whose pupil he was. His appointment represents a notable addition to the strength of the mathematical professoriate in the University of London, and is peculiarly happy in view of the close association of University College, London, with the University College of North Wales during the first five years of the War.

Dr. C. Ainsworth Mitchell and *The Analyst*

DR. C. AINSWORTH MITCHELL, who has been editor of *The Analyst* since 1920, has just retired from this position but retains his connexion with the Society of Public Analysts and Other Analytical Chemists in the capacity of honorary librarian. During the twenty-five years of his editorship, the scope and reputation of *The Analyst* have steadily increased, and it is largely through his exertions that it has attained its present high place among scientific journals and has become recognized as the most comprehensive record of current analytical work in chemistry throughout the world. In fact, the sales to non-members now greatly exceed in number the membership of the Society itself. Dr. Mitchell became a member of the Society of Public Analysts in 1894 and was co-editor with Dr. Bernard Dyer of the jubilee volume, which gave a most interesting account of the progress of the Society from its foundation in 1875. Dr. Mitchell is well known for his work on oils and fats, on vinegar manufacture, and particularly on the chemistry of writing inks and materials, and is the author of much original work in these fields of applied chemistry. His knowledge and experience in the examination of manuscripts and documents have been of service to the courts on many occasions, and his close association with the forensic world was recognized by his election in 1935 as president of the Medico-Legal Society. He is succeeded as editor by Mr. J. H. Lane, who has been assistant editor since 1936.

Australian Council for Scientific and Industrial Research: Retirement of Mr. Gerald Lightfoot

MR. GERALD LIGHTFOOT has retired from the post of secretary to the Australian Council for Scientific and Industrial Research. Mr. Lightfoot has been associated with the Council since its inception, and has played an important part both in the building up and in the running of what is now a great and very effective organization. Mr. Lightfoot has had varied experience; he took a first class in the Mathematical Tripos at Cambridge in 1898 and was called to the Bar at Middle Temple in 1902. A few years later he went to Australia and joined the Commonwealth Public Service, and in 1920 was appointed chief executive officer of the Commonwealth Institute of Science and Industry. When this body was reconstituted in 1926 as the Council for Scientific and Industrial Research, he was appointed secretary, and he held this position until his retirement. He reported to the Commonwealth Government on the work and organization of scientific research institutions in Great Britain and the United States, and in 1937 he visited North America, Great Britain and Europe in connexion with an extension of the Council's activities. Much of the information gained on this visit was used in extending the Council's work to' the secondary industries and in the setting up of several new divisions before the War.

Those who have been associated with Mr. Lightfoot in his work have high admiration for his sound judgment in dealing with major affairs, for his human understanding and kindness in dealing with people, and for his unfailing attention to detail in handling the numerous minor problems which accompany administration. Fortunately, he remains a member of the Council, which will continue to have the benefit of his advice and experience. He has been succeeded as secretary by Mr. G. A. Cook.

Botanist for India at Kew

IT has been announced in *Science and Culture* (India) that Dr. Debabrata Chatterji has been appointed by the Government of India to the post of assistant for India at the Royal Botanic Gardens, Kew. Dr. Chatterji had a brilliant academic career in the Presidency College, Calcutta. After a short period of service as a lecturer in botany at Vidyasagar College, Calcutta, Dr. Chatterji went to the University of Edinburgh in 1937, where he submitted a thesis on "The Endemic Flora of India and Burma" for his doctorate (*J. & Proc. Roy. Asiatic Soc. Bengal*); in this connexion he worked at the Royal Botanic Gardens, Kew, and the British Museum. Returning to India in 1939, Dr. Chatterji took up the post of lecturer in botany at the Agricultural College, Mandalay. Owing to progress made by the Japanese, he was forced to leave Mandalay in March 1942, and from April 1942 he served as a systematic botanist in the Botanical Survey, Government of India, for about a year. Since July 1943, he has been a lecturer at Cotton College, Gauhati, Assam. In 1939, Mr. K. N. Kaul of the University of Lucknow was the first Indian appointed an assistant for India at Kew. Mr. Kaul returned to India at the end of 1944 and will now be succeeded by Dr. Chatterji.

Radar During the War

DURING recent months, much has been published in the daily Press on various aspects of the many different applications of the new technique known as radiolocation or radar; and in *Nature* of September 15, Sir Robert Watson-Watt gave a comprehensive account of the manner in which radar had grown from a classical scientific experiment into a wide series of ramifications developed under the intensive pressure of war. H.M. Stationery Office has now published a pamphlet entitled "Radar—a Report on Science at War" (price 1*s.* net), which is a reprint of an official report issued by the United States Information Service. After briefly surveying the early history of radar both in Great Britain and in the United States, the pamphlet gives an interesting account in general, non-technical language of the important and very interesting part which radar in its various applications played at different stages of the world war. Although the U.S. Naval Research Laboratory and later the U.S. Army were conducting experiments in the reflexion of radio waves from ships and aircraft from the year 1930 onwards, British radar is credited with having been developed at a faster pace from 1935 under the immediate threat to Britain's security. Before the United States entered the War, however, the efforts of American and British laboratories were combined as the result of an agreement between the two Governments in 1940 and the visit of a British Technical Mission to Washington in September of that year. From that time onwards, the combined efforts of the two nations in research and development, training of personnel, and the operational use of this new weapon at sea, on land and in the air make a fascinating story. The concluding section, on "Radar in the Peacetime World", refers to the effect which the spectacular advances in radio technique made during the war years will have on the future of television and in improving the safety of travel by sea and air The number of men who have been trained in radio and radar techniques and maintenance is enormous and many of these will turn their attention to the extended application of electronics in all directions in a manner which is likely to have a profound and far reaching effect on our daily life.

Education in International Morality

THE inaugural meeting of the United Nations Fellowship was held on September 27, when Prof. R. A. Tsanoff, of the American Army University Centre, Shrivenham, Berks, and professor of philosophy in the Rice Institute, Houston, Texas, opened a discussion on "The Problems of Education in

International Morality". Prof. Tsanoff stated that ethics is pre-eminently concerned with the expanding universe of moral ideas, especially of duties and obligations. The lack of correlation—and consequent lack of adjustment—between the scientific and technological and the political worlds has been, in the main, responsible for the disharmony of war. The basic world lesson of the recent conflict, and of the stupendous part played in it by science and technology, points once again the warning finger, that mankind ignores the political implementing of a scientific age at his peril. A global age demands a global politics. The conciliation of, and co-operation between, nations is not merely good ethics; it is the very condition of survival. Neither is a mere truce between the Great Powers enough; they must learn to think in terms of the unity which unites rather than of any disunity which might separate. The recognition of the underlying unity of civilization demands a revolution in the moral and educational outlook—the correction of the 'national political' to the 'global political' outlook. Some countries will have further to go than others to reach this, and, in practice, the change-over will not be easy, for the scarcely dormant and deeply rooted subconscious prejudices of preceding ages will be a constant drag on progress.

The next meeting of the United Nations Fellowship will be held at 29 Gordon Square, London, W.C.1, on October 15, when Prof. Norman Bentwich, professor of international relations, University of Jerusalem, will speak on "The Educational and Cultural Organization of the United Nations". The honorary secretary of the Fellowship is Captain O. H. Cooke, 12 Woodlands, North Harrow, Middlesex.

German Military Maps

A collection of German military maps is on public exhibition during this month at the Royal Geographical Society's House at the corner of Kensington Gore and Exhibition Road. A few of these maps are shown on wall panels: the remainder can be seen in the Map Room on request. These maps are of interest in connexion with German plans for the invasion of England. Those shown on the wall panels include a plan of London on the scale of 1/20,000, emphasizing, in colour and by symbols, buildings and areas of special importance; for example: government offices; main railway stations, marshalling yards, tracks, and bridges; hospitals, industrial sites, and post offices; scientific institutions and historic buildings. A numbered key in the margin gives identifications and brief particulars. There are similar plans on a large scale (1/10,000) of Birmingham, Cardiff and South Shields. A night-flying target map of London, 1/100,000, is also displayed; target areas, outlined in red, include docks, airfields, reservoirs, etc. Other exhibits are a sheet of the *Stellungskarte* of Great Britain, about 2½ inches to the mile, with military information; a sheet, London (West), of the air edition of the German Army map, 1/200,000, with airfields conspicuously marked, and a sheet, Tipperary, of a 1/100,000 map of Ireland. Most of these maps are reproductions on slightly different scales, with additional information overprinted, of maps published by the Ordnance Survey. Official surveys of most countries in Europe were also reproduced by the German Staff, for example, Spain, Portugal, Turkey, Greece and Russia, and representative sheets of these are exhibited.

Announcements

Lieut.-Colonel L. P. Kirwan has been appointed secretary of the Royal Geographical Society in succession to the late Mr. A. R. Hinks. Colonel Kirwan was engaged before the War on archæological and anthropological work, including much work in the field in Egypt, the Sudan, Arabia and England, and for the last three years has been employed on the joint staff in the offices of the War Cabinet.

Prof. Bengt Edlén, of the University of Lund, will deliver a lecture before the Physical Society on "The Spectral Structure of the Inert Gases" on October 19. The lecture will be given in the rooms of the Royal Society; fellows of the Royal Astronomical Society are also invited.

Dr. A. M. Ward has been appointed principal of the Sir John Cass Technical Institute, London, E.C.3, in succession to Mr. George Patchin, who will retire at the end of the present year. The Institute has arranged full-time day classes in chemistry, physics and mathematics for the London B.Sc. degree.

The U.S. Typhus Commission Medal has been awarded to Dr. Francis G. Blake, dean of Yale University School of Medicine, and Dr. Kenneth F. Maxcy, professor of epidemiology at Johns Hopkins School of Hygiene and Public Health, for "exceptionally meritorious service". Dr. Blake initiated and directed investigations of classical importance on the clinical features and prevention of scrub typhus. Dr. Maxcy was commended for "his observations made in the field under difficult campaign conditions, which clarified earlier knowledge of the conditions under which this disease occurs and added greatly to information about the special conditions which were making this disease a health hazard of paramount importance to American troops".

The U.S. War Department states that the Secretary of War has approved a project whereby certain outstanding German men of science and technicians are being taken to the United States to ensure that full advantage be taken of significant developments deemed vital to American national security. The individuals selected have volunteered to go to the United States and have been chosen from fields where German progress is of significant importance and in which these specialists have played a dominant part. Throughout their temporary stay in the United States they will be under the supervision of the War Department.

The following promotions and transfers in the Colonial Service have recently been made: A. G. Beattie (deputy director of agriculture, Nigeria), to be director of agriculture, Nigeria; C. W. L. Fishlock (agricultural officer, Uganda), to be senior agricultural officer, Uganda; H. D. Huggins (agricultural economist, British Guiana), to be agricultural economist, Jamaica; W. T. O. Maidment (agricultural officer, Uganda), to be senior agricultural officer, Uganda; F. R. Sanders (agricultural officer, Tanganyika), to be senior agricultural officer, Tanganyika; C. E. Duff (assistant conservator of forests, Northern Rhodesia), to be senior assistant conservator of forests, Northern Rhodesia; C. Swabey (conservator of forests, Jamaica), to be conservator of forests, British Guiana; W. Pulfrey (geologist, Kenya), to be senior geologist, Kenya; F. E. Tavener (assistant director of surveys, Nigeria), to be director of surveys, Uganda.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Detection of Birds by Radar

PERMISSION has now been obtained to publish the fact that birds can reflect radio waves with sufficient strength to be detected by radar sets. Evidence of this was given to us in the summer of 1941 by Dr. E. S. Shire, then developing centimetric radar equipment at the Air Defence Research and Development Establishment, Ministry of Supply. Confirmation was obtained by G. C. Varley in September 1941, when echoes observed on an operational centimetric set at Dover were established by visual checks to come from gannets (*Sula bassana*) flying singly above the sea. The facts were published in a secret report of the Army Operational Research Group, Ministry of Supply, in April 1942. Much fuller details, with numerous further records, were published in a secret report dated February 1945.

Since 1941, there have been numerous well-authenticated records of birds being detected by radar, first from England, then from Malta and Gibraltar, and later from New Zealand and the United States of America[1]. Indeed, with the introduction of higher powered transmitters late in 1943, bird echoes became such a menace on British coast-watching equipment that we specially trained radar operators to distinguish them from echoes of operational importance. Confusion has occurred with aircraft; but the latter are usually quickly differentiated by their greater speed. More serious is the possibility of confusion with fast-moving ships. Birds not infrequently travel with a ground-speed similar to that of a fast-moving ship, and at long range the echo from a bird flying fully in the beam of a radar set can be equal in strength to that from a ship which is below the lowest maximum of the vertical polar diagram. Birds have given rise to several E-boat scares and to at least one invasion alarm.

That birds give radar echoes is not surprising when it is realized that heavy rain is also detected. Single birds may give echoes not much smaller than those from metal spheres of comparable size. The species involved have been mainly the larger sea and shore birds, such as gulls (*Larus* spp.) and grey geese (*Anser* spp.). However, when in flocks even birds so small as a starling (*Sturnus vulgaris*) have produced echoes large enough to be a nuisance to radar operators. Experimental proof that birds can produce radar echoes was obtained by Major J. A. Ramsay of Coast and Anti-Aircraft Experimental Establishment, when he suspended a herring gull (*Larus argentatus*) from a captive balloon in such a way that the echo from the bird was clearly separable from that given by the balloon.

As yet, the radar results have produced little of ornithological interest except to show how frequently birds fly at night over the sea. However, the radar stations concerned have rarely been allowed to follow bird tracks once their identity has been established. There are two other serious difficulties: first, that of getting visual confirmation of the source of the echo, and secondly, that of following a bird track continuously on a coastal radar set owing to marked variations in signal-strength, including complete fading, due to the bird passing through successive maxima and minima of the vertical polar diagram.

On January 12, 1945, a long track was obtained on birds which later crossed the East Anglian coast near a Royal Observer Corps post, where they were identified as grey geese from their calls. (The pink-footed goose, *Anser brachyrhynchus*, is much the commonest species of goose in the area concerned.) One R.A.F. radar station plotted the birds for fifty-seven land miles, which the birds covered in 99 minutes, giving a ground speed of 35 m.p.h. Adding the plot from a neighbouring station, they covered another 22 miles in 40 minutes (33 m.p.h.). They were travelling on a bearing of 287° at an approximate height of 5,000 ft. The Air Ministry Meteorological Office state that at the time in question the wind at this height was probably about 40 m.p.h. from 070°. If this wind speed is correct, the geese were travelling with an air speed of about 25 m.p.h., which seems rather slow. This record constitutes much the longest timed track so far available for any bird in flight.

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Autotrophic Flagellates as the Major Constituent of the Oceanic Phytoplankton

ALL plankton surveys record the catches of diatoms and often of peridinians, but as a rule little mention is made of the autotrophic flagellates, though it appears quite possible that they make up the greatest proportion of the oceanic vegetation; being very minute they mostly pass through the finest silk nets. Their importance has been pointed out by Gross[1], who, however, supposes their mass to be much less than that of the diatoms and peridinians.

In 1919, Allen[2] published a fundamental observation, that culture methods gave far higher counts for plankton organisms than did either netting or centrifuging. Since then, the mass of plant material in the annual crop has been calculated from the consumption of carbon dioxide and of phosphate[3] and in addition of nitrate, and silicate[4]. These estimations gave 1,200–1,600 tons wet weight per sq. kilometre for the English Channel for all but silicate. The silica consumption gave only 110 tons, and diatoms alone take up silica. It was supposed that the low figure for silica was due to its being dissolved and used over again several times. This process would have to be relatively rapid, as the phosphate is all used up in the spring, mostly in a few weeks. In fact, however, the siliceous test of the diatoms is extraordinarily insoluble. Diatoms, with their fine markings perfect, are dredged from the ocean depths and are recognizable in geological deposits; they are of much importance in identifying oil-bearing strata. Miss F. A. Stanbury and I have tried to dissolve diatom tests in alkaline solutions, from the alkalinity of sea-water upwards to pH 11, both at air temperature and at about 100° C.; we have not succeeded, even with trials of long duration. Furthermore, Coupin[5] showed that diatoms get the substance of their siliceous valves from the silica of silicates of aluminium, not from vitreous or gelatinous silica.

Again, measurements of the light-extinction coefficient of sea-water indicate that it is everywhere much greater than that of distilled water. The difference appears to be due to a suspension of very finely divided mineral matter; this dissolves slowly, and so the silica removed by diatoms is restored, as it is also by the upwelling of the bottom water due to thermal circulation or impact against oceanic banks. Diatom valves may disappear, but Hart[6] has shown that this is due to their fragmentation in the gut of Crustacea, such as *Euphausia superba*.

All these observations are entirely in accord with the view that autotrophic flagellates and peridinians together constitute by far the larger portion of the oceanic phytoplankton. As the peridinians are usually less abundant than the diatoms, the bulk of the productivity may well be accounted for by the flagellates.

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Occurrence of the Diphyllobothriidæ in Ireland

INTEREST in the Diphyllobothriidæ has been aroused by the reported occurrence of plerocercoids in the trout of reservoirs in South Wales[1], in Poulaphouca near Dublin[2], and in Northamptonshire[3]. A general survey of these outbreaks has been given by Lapage[4]. In the Dublin outbreak two species of *Diphyllobothrium* are involved. One of these, which has as definitive hosts three species of gulls, was identified by Baylis[5] as *D. dendriticum* (Nitzsch, 1824) and was considered by him to be identical with the South Wales parasite. The other species, of which the adults were found in cormorants and shags, have been identified tentatively by Dr. Baylis (personal communication) as *D. ditremum* (Creplin, 1825). The separation of the plerocercoids of these two species has not yet been effected.

A third species, *D. latum* (Linn., 1758), has for long been known to occur in Ireland. The species was first recorded from man in Ireland by Bellingham[6]. A number of modern cases have been published, all from patients in the County Leitrim area[7]. Dr. T. V. McLoughlin kindly sent a further specimen of *D. latum* to us. This specimen was obtained in October 1944 from a boy aged fourteen, who gave a history of occasionally eating perch from Gardice Lake, Co. Leitrim. Accordingly it was considered desirable to examine fish from this district.

Perch were obtained from Gardice Lake and from he first half-mile of a canal which passes through this Lake and joins it with a number of other lakes in the vicinity.

Seventy-nine perch were examined, and of these hirty-five were infected with plerocercoids. The fish varied from 9·5 to 24·7 cm. in length, sixty-one ranged from 10 to 15 cm. and sixteen from 15 to 20 cm. The findings for these two groups are given in Table 1.

TABLE 1.

No. of plerocercoids per fish	Nil	1	2	3	4	5	6	7	8	
No of fish in Group 1 10–15 cm. in length	40	14	5	2	–	–	–	–	–	61 fish examined
No of fish in Group 2 15–20 cm. in length	4	4	2	2	1	1	–	1	1	16 fish examined

Two of the fish examined are not included in the table; one of these, 9·5 cm. in length, contained no plerocercoids, and the other, 24·7 cm. in length, contained thirteen plerocercoids. Similar plerocercoids were found in each of two perch obtained from Lough Allen on the River Shannon, Co. Leitrim.

Plerocercoids from the Gardice Lake perch were used in the following experiment. Two adult dogs were fed, one with eight and one with two plerocercoids. In the fæces of the dog which had received eight plerocercoids *Diphyllobothrium* ova were present sixteen days later. This animal continued to pass ova for four weeks. The worms were then passed spontaneously. Ova were found in the fæces of the second dog twenty-seven days after feeding. This animal was given an anthelminthic eighty-two days after feeding and two specimens of *D. latum* were obtained. We are indebted to Dr. H. A. Baylis for examining one of these.

A superficial comparison between the *D. latum* plerocercoids and the plerocercoids obtained at Poulaphouca Reservoir, Dublin, is of interest as several morphological and ecological differences were observed.

The *D. latum* plerocercoids were opaque and had a dull white appearance. Living specimens were only sluggishly motile and seldom relaxed sufficiently to lose their typical irregular, deeply wrinkled appearance. When killed in tap water, the scolices usually remained invaginated and the deep wrinkles, in varying intensities, were always present. Of the eighty-one plerocercoids located in the fish from Gardice Lake, seventy-one were found in the skeletal muscles and only ten in the peritoneal cavity or abdominal viscera. On section, no inflammatory reaction was observed in the surrounding tissue.

Plerocercoids from the fish of Poulaphouca Reservoir are rather translucent and have a glistening white appearance. When living they are actively motile and except when strongly contracted deep wrinkling is not apparent. They invariably relax when killed in tap water, their scolices evaginate and assume a lanceolate or almond-shaped appearance, and wrinkles are never present although some specimens show segmentation. Two plerocercoids were found in the skeletal muscles of one out of one hundred and ninety-eight infected trout examined to date from Poulaphouca Reservoir. Otherwise the infection in these fish was confined to the viscera and subserous tissues of the abdominal cavity; an inflammatory mass of blood-stained granulation tissue was frequently present.

Fish from some Irish waters other than those mentioned above were examined. In the following localities plerocercoids, which superficially appeared similar to those from Poulaphouca Reservoir, were found in trout (*Salmo trutta*), salmon (*S. salar*) and char (*Salvelinus colii*).

TABLE 2.

County	Habitat	No. of fish examined	No. of fish infected	Remarks
Wicklow	Reservoir	14 brown trout	13	Fish 19–31·7 cm. in length. Plerocercoids present varied from 2 to more than 200 per fish
Dublin	,,	17 brown trout	1	Single infected fish 63 cm. in length had 3 plerocercoids
Mayo	Lough Mask	8 brown trout	2	Fish 30·5–35·7 cm. Those infected contained 32 and 10 plerocercoids respectively
Galway	Four lakes in Connemara	25 brown trout	2	Two infected brown trout, 35 and 36·7 cm., had 3 and more than 100 plerocercoids. Uninfected fish were less than 15 cm. in length.
,,	,,	20 sea trout	6	Sea trout, 22·3–41·3 cm. Only one or two plerocercoids in each fish
,,	One of these lakes	3 salmon	1	Infected salmon, contained two plerocercoids
Donegal	Lough Eak	3 char	3	Each char contained more than 50 plerocercoids

Mortality owing to the presence of the parasites was not recorded in any fish other than those from the Poulaphouca Reservoir.

One of us (M. D. H.) is in receipt of a grant from the Medical Research Council of Ireland.

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Periodate Oxidation of Sugars in Neutral Phosphate Buffer

WHEN yeast mannan was oxidized with sodium periodate in phosphate buffers of various pH values, it was discovered that the amount of oxygen consumed during the oxidation is enormously increased when the pH of the solution is raised above 4–5. At $p\text{H} = 7$, the consumption of oxygen is about ten times as large as at $p\text{H} = 3$[1]. It was shown that two thirds of the mannan molecule is oxidized to carbon dioxide at $p\text{H} = 7$ and 50°. The reaction seems to be catalysed by phosphates, for the velocity of oxidation is much lower in an acetate buffer of $p\text{H} = 5{\cdot}3$ than in a phosphate buffer of the same pH.

A number of sugars and similar compounds have been oxidized in the same way by sodium periodate in a phosphate buffer of $p\text{H} = 7{\cdot}0$ at 50°. The concentration of periodate in the solution was about 0·05 m. The amount of periodate consumed was determined by iodometric titration in an excess of the same phosphate buffer. At this pH, iodate does not react with potassium iodide, and each mole of periodate will liberate only two atoms of iodine. The time required for complete oxidation was 12–15 hours except in the case of α-glycerophosphate, which was oxidized very slowly. The accompanying table gives the end values of oxygen consumption in these experiments compared to the results found by other investigators in strongly acid solution.

Substance	Phosphate buffer $p\text{H} = 7{\cdot}0$	Strongly acid solution	
	Atoms of O per mole	Atoms of O per mole	Found by
Xylose	4·4	4	Khouvine, Arragon[1]
Glucose	5·2	5	Fleury, Lange[2]
Mannose	5·2	5	Fleury, Lange[2]
Fructose	5·3	5	Khouvine, Arragon[1]
Mannitol	5·2	5	Malaprade[4]
α-glycerophosphate (sodium salt)	5·9	1	Fleury, Paris[5]
α-methyl glucoside	10·1	2	Héri sey, Fleury, Joly[6]
Glucose-*l*-phosphate (potassium salt)	8 8	2 (theoretical)	Not investigated
Maltose	18·1	10*	Ahlborg[7]
Trehalose	19·6	4	Jackson, Hudson[8]

* At $p\text{H} = 3$, maltose consumes only 4 atoms of O per mol (Ahlborg, not published).

A preliminary investigation showed that other disaccharides (sucrose, lactose, melibiose) also consume 16–19 atoms of oxygen per mole when oxidized under the same conditions.

The following conclusions may be drawn from the experiments:

(1) Monosaccharides and polyalcohols, the carbon chain of which is broken completely by periodate oxidation in acid solution, are oxidized in the same way in a neutral buffer.

(2) If a mono-, di- or poly-aldehyde containing hydroxyl groups is formed by acid periodate oxidation, much more oxygen will be consumed in neutra than in acid solution, and the bulk of the molecule is oxidized to carbon dioxide. Probably the 'normal oxidation first takes place, yielding formic acid, formaldehyde and the oxaldehyde, which is ther broken down completely.

The Warburg method was employed to measure the amount of carbon dioxide liberated during the oxidation. One of the side bulbs of the Warburg flasks contained 0·1 m. $NaIO_4$ solution and the othe 4 N H_2SO_4. The oxidation was started by tipping the periodate into the solution. When no mor carbon dioxide was evolved, the acid was added from the other side bulb to expel all carbon dioxide from the solution. The following results were obtained

Substance	Moles of CO_2 per mole	Temperature
α-glycerophosphate (sodium salt)	2·0	50°
α-methyl glucoside	3·8	40°
Glucose-*l*-phosphate (potassium salt)	3·7	40°

The complete course of this new type of periodat oxidation cannot be accounted for as yet. Probabl there are also other oxidation products in addition t formaldehyde, formic acid and carbon dioxide. Eve in acid solutions the same reaction may be observed as a secondary reaction, at least when the temperature is raised to 40°–50°. That will explain wh some investigators have found that the periodate consumption increases slowly all the time and never comes to a standstill.

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Influence of Vitamin E on the Utilization of Carotene from Oils

IN a previous communication[1], it was indicated that the variations in growth response of vitamin A-deficient rats to carotene dissolved in different oils may be due to the difference in vitamin E contents of the oils. The effect of equalizing the level of tocopherol in the supplements has since been studied and the results found to support the explanation.

Young rats were depleted of vitamin A reserves on a diet consisting of 68 per cent sucrose, 18 per cent extracted casein, 10 per cent brewers' yeast and [illegible] per cent Osborne and Mendel salt mixture, and supplemented with 1 µgm. of calciferol a week. When symptoms of deficiency were observed, the rats were divided into groups and given the supplements of carotene and tocopherol, six days in the week, as stated in the accompanying table. The fæces of the rats were collected for fifteen days, and the excreted carotene determined by the method of Ramasarma and Hakim[2].

The vitamin E contents of the groundnut, olive and coco-nut oils used in the experiment, determined by a modification of Moore's procedure[3], were 386, 175 and 0 µgm. per gm. respectively. It may be seen that the total vitamin E ingested by rats in groups *G*, *O* 2 and *C* 3 was practically the same, namely, [illegible]8·6 µgm. daily, as also in groups *O* 1 and *C* 2, namely, [illegible]7·5 µgm. daily.

Group	No. of rats	Supplements	Gain in wt.		Carotene excreted %
			3 weeks (gm.)	5 weeks (gm.)	
G	6	1 µgm. carotene in 100 mgm. groundnut oil	16	22	7
O 1	6	1 µgm. carotene in 100 mgm. olive oil	12	16	0
O 2	6	1 µgm. carotene and 21·1 µgm. α-tocopherol in 100 mgm. olive oil	14	20	0
O 1	5	1 µgm. carotene in 100 mgm. coco-nut oil	4	7	0
C 2	6	1 µgm. carotene and 17·5 µgm. α-tocopherol in 100 mgm. coco-nut oil	9	13	0
C 3	6	1 µgm. carotene and 38·6 µgm. α-tocopherol in 100 mgm. coco-nut oil	14	17	trace

The control groups of rats given the different oils, and one group on tocopherol in coco-nut oil, declined in weight and died.

The results show that the wide variations in growth-response to 1 µgm. of β-carotene in groundnut, olive and coco-nut oils were reduced when pure α-tocopherol was added to the oils low in tocopherol, and the total intake of vitamin E thus equalized. The slight persistent difference might be due to the occurrence in the oils of other isomeric tocopherols which are more efficient antioxidants than α-tocopherol[4].

Gridgeman[5] failed to confirm the vitamin A-E synergy, but the results given above support Hickman's[6] conclusions. Experiments with other dosage levels of tocopherol are in progress.

I am grateful to Prof. V. Subrahmanyan for his keen interest in the work, and to the Lady Tata Memorial Trust for the award of a scholarship.

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Frost Injury Simulating Virus Disease Symptoms on Potato Foliage

THE production of virus-free seed potatoes has been a matter of increasing interest in the British Isles during recent years. The methods of building up healthy stocks originally adopted in Ireland and now being favoured elsewhere consist, briefly, in the scientific testing of selected plants in the glasshouse and the subsequent propagation of proved healthy units in isolation in the field. Foundation stocks produced in this manner are distributed to the growers, whose crops are subject to a rigid system of inspection before being certified for seed purposes.

In the working of such a scheme, not the least difficult part is that of the potato inspector, who must diagnose virus infection in the field; and it is in this connexion that we wish to direct attention to the effects of frost on potato foliage. The majority of agriculturists are familiar with the type of injury caused by late spring frosts, such as occurred in April and May of this year; and it is probable that most potato inspectors can also recognize the after-effects of such frosts although these may not be obvious until four to six weeks after the damage has occurred. These effects have been described by Murphy and McKay in a previous publication[1]. Little appears to be known, however, regarding the possible damage to potato foliage caused by the dropping of night temperatures below freezing point during June and early July. So far as we are aware, the only previous reference to such injury is that by MacMillan[2], who describes the development of necrotic spots on the tops of potato plants due to sudden cooling at night during summer. Symptoms of this type have not been observed by us, but evidence of a circumstantial character has been accumulating which suggests that cold nights in early summer are liable to produce other effects which may be mistaken for virus disease symptoms. As in the case of late spring frosts, it would appear that these effects may show up almost immediately, or their development may be delayed until leaves which are still folded at the critical period become fully expanded. A few instances will serve to illustrate this point.

In 1929, one of us (R. McK.), in company with the late Dr. Davidson of the Department of Agriculture, inspected a crop of potatoes grown for seed purposes in a low-lying peaty field in Co. Donegal. The crop consisted of five varieties, Up-to-Date, Sharpe's Express, Kerr's Pink, King Edward and Arran Chief. These were grown in contiguous long strips of twelve drills each in the order named. A sharp frost had occurred on July 7, and when the inspection was made ten days later, the top growth of the Up-to-Date, Kerr's Pink and Arran Chief was strongly mottled and the leaflets somewhat distorted, while only an occasional plant of Sharpe's Express and King Edward showed pale blotches. The result was that at a distance of thirty yards, the location of the former varieties was clearly discernible by reason of their yellowish mottled hue. Although any individual affected plant might reasonably have been diagnosed as suffering from virus infection, the previous history of the crop, and the manner in which the symptoms developed, left no doubt that the effect was entirely due to frost. The difference in reaction of the varieties was ascribed to the fact that a dense mass of foliage was present on those which showed most mottling, while the drills of Sharpe's Express and King Edward were still open. The erect tops of the latter would therefore have been drier owing to the free circulation of air about them.

In the same year, another suggestive incident occurred in one of the Northern counties. A crop of Arran Victory grown from a special stock of certified seed was rejected on inspection because practically every plant showed mottling. Seed from the same stock planted on higher ground on a neighbouring farm produced a perfectly normal crop and was awarded a stock certificate. The inspector took the view that in the former case old seed must have been mixed with the new in order to augment the crop. The plants were seen by one of us about the middle of August, but by that time they were approaching maturity and foliage symptoms were obscured by a deposit of spray. It was noticed, however, that the field was situated in a hollow, and, suspecting frost injury, an interest was taken in the subsequent history of the stock. In the following year, a crop from the tubers of the supposedly diseased plants was absolutely free from mottle; the stock was continuously grown in isolation, and six years later its descendants were sufficiently healthy to qualify for the highest grade certificate.

In July 1944, complaints were made that certain crops of Arran Pilot potatoes grown in Ireland from certified seed showed widespread mosaic, while seed from the same stock grown in other localities produced normal plants. During the last week of June 1944, night temperatures of 35° F., 32° F. and 33° F. were registered in Dublin, while in many inland localities and in the north one or more degrees of frost occurred. Samples of the affected Arran Pilot plants were obtained by us, and the tubers taken from them were grown both in the glasshouse and out of doors this year. No disease symptoms appeared in any of the plants, and tests revealed that the only virus present was an extremely mild strain of virus X. Here again, the circumstances suggested that frost was responsible for supposedly severe virus disease symptoms.

More direct evidence of the development of mosaic mottling in potato foliage due to low temperatures was obtained this year. On March 26 a severe frost occurred which caused considerable damage out of doors. In a cold greenhouse at the Albert Agricultura College devoted to the propagation of virus-fre potato units, it was observed on April 9 that whereas the plants generally were unaffected, one small shoot of a President plant displayed a conspicuous ligh and dark green mottling of the leaves, typical o that produced by a non-necrotic strain of virus X This shoot had emerged close to the rim of the po and was about 2½ in. high when first noticed, whil the central shoots were 6–7 in. high. Having firs ascertained that the affected shoot originated fron the tuber sett, tests were made which establishe conclusively that it was not infected with any of th known mosaic viruses. Moreover, the remainder o the plant failed to show any disease symptoms u to the time of maturity, nor was it possible to demonstrate the presence of virus in its foliage. Accordingly it is believed that the mottling was an effect of lov temperature, acting on a shoot which was rendere susceptible by reason of its stage of development an location of its tip close to the soil or rim of the po just at the critical period.

Although the available evidence is mainly of circumstantial character, it is sufficiently suggestiv to warrant an investigation of frost effects in genera on potato foliage. In the meantime, potato inspector who observe wholesale mottling of crops grown fron certified seed should bear in mind the possibility o frost injury, and should endeavour to have representative plants scientifically tested before condemnin the stock. For various reasons, the cold wind-swep northern districts are those favoured for the propagation of seed potatoes, and it is just in such localitie as these that low night temperatures are most likel to prevail during the summer months.

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An Arsenic-Resistant Tick

THE article "Biological Control as a Supplemen to Chemical Control of Insect Pests", by Dr. W. E Ripper in *Nature* of April 15, 1944, mentions seve species of injurious insects which have evolved race more resistant to certain insecticides than are th ordinary populations of those insects.

We have encountered this phenomenon in a arachnid, *Boophilus decoloratus* (Koch), a one-hos tick, commonly called the 'blue tick' in South Africa Resistance to arsenical dips was first noticed in th tick in 1938 at East London, South Africa, when th trouble was confined to a small area. Its sprea north and south along the coast, was rapid, and i 1940 it was clear that the arsenic-resistant tick ha established itself in the Bathurst district. This wa sufficiently close to our laboratories to allow us t make extensive experiments and observations. W are unable to recall here the long and varied serie of experiments carried out during the past five year when many thousands of ticks have been treate with many different chemicals. The results of thes experiments were often inconclusive owing to ou uncertainty of technique and also to the fact tha we were dealing with mixed populations of ticks.

In 1944 we began investigations on a new chemic which enabled us to perfect our technique. How ever, it was not until May 1945 that we obtained a sufficiently large number of ticks from a presumed 'non-resistant' area to test alongside ticks from a presumed 'resistant' area. These two gatherings of ticks arrived at our laboratories within forty-eight hours of each other, and batches of a hundred fully engorged female ticks from each locality were dipped in arsenical solutions of different concentrations. A hundred ticks from each area were treated in tap water as controls. After dipping, the ticks were dried in a manner simulating natural conditions, and they were then placed in pairs in tubes and kept in an incubator at 25° C. and 100 per cent relative humidity.

In both cases the tap water had little or no effect on laying, as 95 per cent and 93 per cent of the ticks so treated laid large batches of eggs, and hatching was also heavy.

Ticks from the presumed 'non-resistant' area responded readily to the arsenical treatments, as only 37 per cent laid after treatment in 0·16 per cent As_2O_3 (7-day dipping strength), while 0·32 per cent As_2O_3 and 0·64 per cent As_2O_3 reduced laying to 7 per cent and 1 per cent respectively. The effect of the arsenic on hatching was also apparent, as only three batches of eggs laid by ticks treated in 0·16 per cent As_2O_3 showed partial hatching. The treatment has to all intents and purposes resulted in a perfect control.

On the other hand, ticks from the presumed 'resistant' area were little affected by the arsenical washes, as laying occurred in 95 per cent, 83 per cent and 63 per cent of the ticks treated in 0·16 per cent, 0·32 per cent and 0·64 per cent As_2O_3 respectively. Hatching was also fairly heavy, as 76, 68 and 35 of the batches laid by ticks treated in 0·16 per cent, 0·32 per cent and 0·64 per cent As_2O_3 showed hatchings. In this case the treatment has resulted in a very imperfect control, even with concentrations of As_2O_3 which would injure cattle.

It is also interesting to note that the arsenical solutions produced a well-marked time-lag in egg laying, which is also further emphasized in the hatchings. This lag is so constant that it cannot be explained by experimental error.

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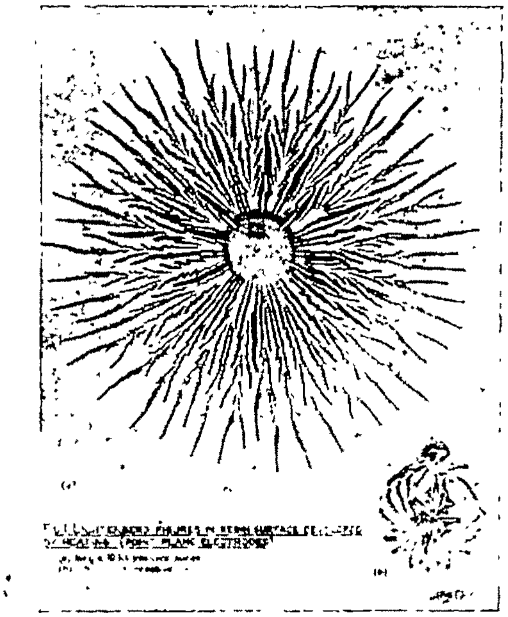
June 26.

Electric Discharge on a Dielectric Surface (Lichtenberg Figures)

The following method of developing a latent Lichtenberg figure on the surface of certain types of solid dielectrics is very successful. So far, only a 'silicon' type of synthetic resin, 'Novalak' (fusible phenol formaldehyde polymer), ester gum and cumar resin have been used; but it appears necessary merely that the dielectric should be hard and brittle at ordinary temperatures and should soften quickly at some higher temperature. For example, in one experiment a piece of the resin was fused and poured on a clean glass plate to form, when cool, a hard smooth and uniform coating. This was placed between a needle point and an earthed metal plate. A single positive (or negative) voltage surge of magnitude 10 kV. was applied. No change of the surface was visible. On gently heating the resin coating, however, until the softening temperature was just reached, thread-like grooves appeared which, in a few moments, assumed the characteristic form of a Lichtenberg figure. At this instant the heating was stopped, otherwise the figure disappeared rapidly as the resin liquefied.



To photograph the figure, the coated plate was placed in a photographic enlarger, in the position normally occupied by a negative. A black disk superimposed over the image of the illuminant, formed in front of the lens, stopped all the emergent light except that differently refracted by the minute grooving. The accompanying reproduction shows the results obtained with a positive and negative surge respectively.

It is hoped to give later a detailed explanation of the mechanism; its association with bound electrostatic charges and the resultant attraction is clear.

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Formation of an Addition Compound of Calcium Silicate and Sodium Fluoride

In connexion with some experiments concerning the decomposition of calcium fluoride by fusing with silica and sodium carbonate, the formation of needle-shaped crystals was observed. The crystals were analysed, and it appeared that the formula of the compound must be Ca_2SiO_4NaF, as is seen from the following data:

	% CaO	% SiO_2	% Na	% F.
Observed	51·5	28·6	11·0	8·5
Calc. for Ca_2SiO_4NaF	52·36	28·04	10·74	8·87

An X-ray investigation of the compound by the Laue, rotation, and Weissenberg methods has given the following results. The Laue symmetry is $C_{2h}-2/m$. The deviation from the symmetry $D_{2h}-mmm$ is, however, very slight. The diagonal axis is perpendicular to the direction of the fastest growth of the crystals. The dimensions of the unit cell are the following: $a = 20 \cdot 6$ A., $b = 21 \cdot 1$ A., $c = 7 \cdot 55$ A., $\beta \sim 89 \cdot 5°$. The density is 2·98. This value corresponds to 27·6, that is, 28 formula units in the unit cell. As in all photographs the reflexions from the faces $h0l$ with $h + l = 2n + 1$ and $0k0$ with $k = 2n + 1$ are missing, the space group $C_{2h}^5 - P2/c$ is probable. An investigation of the grouping of the 252 atoms in the unit cell has not been attempted.

Powder photographs of melts with the following compositions were taken:

(1) $2(2\ CaO + SiO_2) + NaF$
(2) $2\ CaO + SiO_2 + NaF$
(3) $2\ CaO + SiO_2 + 2\ NaF$
(4) $2\ CaO + SiO_2 + 3\ NaF$.

Preparation 1 showed the reflexions of Ca_2SiO_4NaF and some other lines which could not be identified. Preparation 2 showed only the reflexions of Ca_2SiO_4NaF. Preparations 3 and 4 showed the lines of Ca_2SiO_4NaF and of NaF. In all photographs the interferences belonging to the Ca_2SiO_4NaF phase were identical as regards intensity and position. Thus the stoichiometrical composition of Ca_2SiO_4NaF seems to be very well defined, and no addition compounds with the ratio NaF : Ca_2SiO_4 greater than 1 seem to exist.

I should like to thank Mr. Bengt Åman for his assistance in part of the experimental work.

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June 27.

Emission Bands of the Fluctuation Type in the Spectrum of Iodine

As part of an investigation undertaken in this laboratory on the emission spectra of halogens and halogen derivatives of methane[1], the emission spectrum of iodine is being studied. The spectrum is excited by a high-frequency as well as a transformer discharge in iodine vapour of pressure equivalent to the saturated vapour pressure of iodine at room temperature. A Steinheil 3-prism glass spectrograph and medium Hilger quartz and constant-deviation glass spectrographs have been used as resolving instruments. Super Panchro-press *P* 1200 and Process Regular *B* 20 Kodak plates were used.

The spectrum in all cases consists of a large number of diffuse broad bands in the region 4800–3450 A. to which, only, the present note relates. Previous investigators[2] have, however, recorded in this region only wave-lengths of the maxima of two continuous (?) bands at 4800 and 4300 A. and a weak one at 4020 A. In the present experiments the so-called continuous band at about 4800 A. is one of the eight diffuse bands which form one group. Similarly the band at about 4300 A. is one of the seven and that at 4020 A. one of the five bands in the second and third groups respectively. Between 3950 A. and the well-known continuum at 3414·3 A., we have the fourth group of such diffuse bands.

All these details are more clearly brought out on the process than on the panchromatic plates, which do not give much contrast. It is probably for this reason and also because low-dispersion instruments are generally used in this rather difficult region, particularly below 4100 A., that the details of the spectra might have escaped the attention of previous investigators. Thus, for example, the four bands observed here between 4094 and 4017 A. appear, under low dispersion, as a single band. The accompanying table gives the wave-lengths of the maxima of all the bands observed in the region 4750–3475 A. The intensities given refer to visually estimated values for the bands as obtained on the process plates, the sensitivity of which falls rapidly above 4350 A. For this reason, the intensity values of the first group of bands do not give correct information of the relative intensities of these bands. The panchromatic plates show that the bands at 4747·2 and 4662·1 A. are, along with that at 4575·6 A., the strongest in the first group.

Group	Int.	λ in air (A.)	ν vac.	Group	Int.	λ in air (A.)	ν vac.
I	0	4747·2 *B*	21059	IV	10	3944·1	25347
	1	4662·1 *B*	21444		2	3918·7	25511
	3	4575·6 *B*	21849		6	3879·7	25768
	2	4517·7	22129		6	3855·8	25928
	4	4471·0	22360		3	3820·1	26170
	2	4430·7	22563		4	3798·0	26322
	3	4389·4	22776		1	3770 4	26515
	8	4353·3	22965		1	3751 2	26651
					1	3739 5	26734
II	5	4316 8	23159		2	3720·1	26873
	8	4230·9	23353		2	3685·6	27118
	8	4241·8	23568		2	3668·9	27248
	6	4201·5	23794		2	3640·2	27468
	5	4155 5	24058		2	3622·8	27595
	4	4123 3	24246		2	3600·7	27764
					2	3577·4	27945
III	5	4093·5	24422		1	3535·4	28277
	5	4067·0	24581		?	3513·1	28457
	5	4044·9	24716		1	3500·1	28562
	3	4017·4	24885		1	3479 6	28731

The bands seem clearly to belong to the so-called fluctuation type of bands[3] and are probably due to a transition between two electronic states, the lower of which possesses a flat potential energy curve. The first three bands are very broad (*B*), the over-all widths being about 332, 239 and 240 cm.$^{-1}$ respectively. All the other bands which are also broad have an average width of about 115 cm.$^{-1}$. This fact probably indicates that the flat final level is common to all of them. Excepting the first three bands in group I, the average wave-number difference between successive bands in the first two groups is about 214. The same difference in bands of group III is about 154. The bands of group IV appear to occur in doublets of which six are very obvious and are shown as such in the table. The average wave-number difference of these doublets is again of the order of 158. The occurrence of these two wave-number differences ($\sim$ 214 and 154) strongly suggests that the bands are due to the diatomic molecule I_2. This and the fact that the bands occur in four distinct groups suggest that they involve more than one electronic level for their initial states, the wave-number differences between corresponding bands of successive groups being of an order of magnitude which is too big to be regarded as a vibrational frequency of the iodine molecule. Further elucidation of these bands must await the investigation on the other regions of the iodine spectrum which is in progress.

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June 4.

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[1] Cf. Asundi, Singh and Mishra, *Curr. Sci.*, **12**, 204 (1943).
[2] Cf. Curtis and Evans, *Proc. Roy. Soc.*, A, **141**, 603 (1933).
[3] Herzberg, "Molecular Spectra", 462 (1939).

CARNEGIE INSTITUTION OF WASHINGTON

ANNUAL REPORT

YEAR BOOK No. 43 of the Carnegie Institution of Washington for 1943–44 covers the year July 1, 1943–June 30, 1944, including the reports of the executive committee, of the auditors and of the president, together with reports on departmental activities and co-operative studies, and a bibliography of publications of the Institution, November 1, 1943–October 31, 1944. The report of the president, discussing chiefly the Institution's plans for the future and the problems of transition from war to peace, points out that military research is likely to continue on a more extensive basis after the War. Recognizing the conviction that the United States must participate actively in definite efforts to maintain the peace, he points out that the world has the best opportunity possible for a long peace if the United States remains strong, and an essential ingredient is continued attention to possible military applications of science. Such military research in normal times can be more appropriately done by organizations the work of which is closer to definite application than the Institution itself.

The most important element in the Institution's planning is definition of the programmes of the several departments, and such definitions should not be so rigid as to exclude the seizure of unexpected opportunities. Dr. Vannebar Bush also emphasizes the Institution's need of men of different talents and calibre, since research is usually an affair of well-constituted teams; but mediocrity in its objectives or accomplishments cannot be tolerated. An adequate approach to the formulation of long-range programmes of research in the different departments can be made only if the aims of the Institution as a whole are clearly grasped. In view of the opportunity of the Institution for the interpretation and dissemination of scientific research, he suggests that reasonable and dignified provision for such efforts might appear in its plans. It is important to ensure that its internal policies and external relations are in sound condition for the task. He also comments on the beneficial results of relations between industrial research laboratories and those of the Institution.

The report of the Department of Astronomy refers to a reduction in the astronomical work of the Mount Wilson Observatory. The most interesting observational result of the year was the resolution of several extragalactic nebulæ among the two companions of the Andromeda nebula and the central region of the Andromeda nebula itself. For this purpose, red-sensitive photographic plates were used with a filter transmitting a very limited spectral region. The participation of the Geophysical Laboratory in the war effort continued along the same lines during the past year as described in the last two annual reports. The report includes abstracts of a few papers published in technical journals during the past year and representing previous work of the laboratory. The Department of Terrestrial Magnetism continued its analyses of cosmic data, which have continued to increase polar, geomagnetic, ionospheric and auroral correlations. The Department undertook to serve as a clearing house for observations of sunspots by American observers pending re-establishment of communications with the international centre at Zurich. Important contributions leading to improvement of the radio-communication circuits resulted from the continued operation of ionospheric recorders, and the 60-in. cyclotron was completed in December 1943. The report of this Division also includes an account of cosmic ray studies at the California Institute of Technology and of cosmic ray research at the University of Chicago.

The Division of Plant Biology continued to devote much of its effort to problems arising out of the War and, in co-operation with the College of Pharmacy of the University of California, investigated the isolation of a new antibiotic, chlorellin, which is obtained from the green unicellular alga *Chlorella*. Facilities for the culture of larger quantities of the organisms and methods for the extraction of chlorellin have been worked out, and some preliminary tests made with animals. In co-operation with the U.S. Soil Conservation Service, the staff of the Division has also undertaken a programme for the production of new range grasses, utilizing principles recently worked out in the Division. Grass stocks from many parts of the world are being employed, and in 1943 seven different cross-pollinations were made between members of two sections of the genus *Poa*; these have been augmented by twenty-four additional combinations tried under better conditions during 1944. The hybrids obtained demonstrate that remotely related species of *Poa* can be crossed successfully. Hybrids are sought that will combine hybrid vigour and greater climatic tolerance, drought and disease resistance and greater soil-holding capacity with a longer period of use for livestock. Very little field-work has been done in any of the Division's projects.

The Department of Embryology continued its studies on the physiology of reproduction in the Rhesus monkey and other animals on a small scale. The report includes brief accounts of work in human embryology, the exchange of substances between the blood and surrounding tissues, tumour studies, nutrition and the comparative anatomy of primates.

The Department of Genetics investigated the origin of resistance to penicillin in *Staphylococcus aureus* and has found that strains resistant to increasingly higher concentrations can be produced by selection, resistance apparently being acquired through mutation. X-ray experiments with *Penicillium notatum* have shown that morphologically detectable mutants can readily be induced, and the frequency of mutants increases with the dosage, reaching 45 per cent at 100,000 roentgens. Studies of mutation in bacteriophages showed that radiation causes a marked delay in their reproduction. A study of the genetics, taxonomy and ecology of flies related to *Drosophila pseudoobscura*, representing a two-year period, is included, and is chiefly concerned with clarifying the concept of biological race and with methodology of racial studies. Investigations on the incidence of spontaneous mouse leukæmia confirm that the role of longevity is far more complex than had been supposed and appears to depend on numerous variables, both genetic and non-genetic. Polyploidy investigations recorded concerned the Russian dandelion and hemp; where, as a war emergency project, an attempt has been made to produce a strain of fibre hemp with reduced marihuana content. Endocrine studies on doves and pigeons have shown that the development of endosteal bone following dosage with œstrogenic hormone occurs in the absence of the parathyroid glands, and the evidence indicates that it is probable that most of the 'bound' calcium is attached to the phosphoprotein, serum vitellin. The Nutrition

Laboratory continued to be concerned mainly with war research projects, carried out a special investigation on the metabolism of diabetes mellitus, and made a study of physiological clinical interest on the breathing pattern and rate of air flow in asthmatic patients. Special projects in the biological series also reported include the results of studies on Diatomaceæ, embryology, embryological pathology and reproductive physiology, the maintenance of a *Drosophila* stock centre in connexion with investigations on the constitution of the germinal material in relation to heredity, and the influence of nutrition on the chemical composition of the normal body.

THE BRITISH PIG-RAISING INDUSTRY

As a part of farming which has had very low priority during the war years, pig production shows clearly some of the major problems confronting the British livestock industry. The scope and form of development must depend upon the broad framework of policy as laid down by the State; yet a policy as a whole is often difficult to break down into terms applicable to individual farms and herds. Throughout the discussions on pig production at the meeting on July 17 of the British Society of Animal Production, it was obvious that these considerations were well in the minds of all speakers, though the question of what will be the post-war politico-economic status of the pig industry was not directly raised.

Pre-war, pig production was largely based upon imported feeding stuffs, and often, like poultry, it was carried out on specialized, intensive lines. During the last five and a half years, breeders and feeders have had to rely on home-grown food supplies, eked out where possible by swill and house refuse. Must the industry now await, even passively, the return of large importations of maize and other feeding stuffs? Or must it continue as a dispersed, small-unit enterprise—pigs on all farms—using home-produced fodders?

The change-over from pre-war methods to war-time expedients required considerable modifications of husbandry and management, yet the pig breeder had often little enough evidence or experience to help him solve the local nutritional problems exposed by the locally available foodstuffs. The investigations in Northern Ireland described by Prof. R. G. Baskett formed one of the attempts to help in the immediate adjustments of feeding methods to means. The disadvantages of oats as pig feed were well recognized, but the trials showed that, with proper precautions as to their low starch equivalent value and high fibre content, oats could be used so as to give satisfactory live-weight gains, though with less efficient food utilization. Prof. Baskett considers that similar use of oats could be made in other parts of the United Kingdom where they are the main crop, although he holds the view that, in the long run, the pre-war levels of pig population must depend upon a return to maize imports. On the other hand, practical opinion from the west of Scotland, supported by experience in parts of England, such as East Anglia, did not share this view, but favoured a more intensive exploitation of local foodstuffs, together with greater attention to appropriate management. In any circumstances the pig enterprise on a farm, whether general or specialized, needs careful planning, not merely for supply and use of feeding stuffs but also in regard to buildings, husbandry and disease control. In all these there is still great scope for improvement, which, together with more knowledge and practical experience in the feeding of potatoes, barley and dairy by-products, holds promise for an expansion and increasing efficiency of pig production. Confidence in the future would be greater provided that there were an intensification of research effort upon local problems, as well as on general principles, which could throw light upon how to make improvements within the present, or likely, cost structure of the industry.

Feeding and management, however, form only part of the problem. As Dr. John Hammond pointed out, the present low numbers of commercial pigs provide an opportune setting for the development of suitable breeding materials and methods, and of definite policies of genetic improvement. The new boar licensing scheme is a move towards restricting the kind of sire which can be used for breeding purposes, but several speakers argued that more positive methods are needed to steer the industry towards higher levels of efficient production. The nature of these positive methods can only be decided from a greater application of investigation and use of appropriate data. At present the data on fertility, weight gain and carcase characters are too sparse to serve as more than indications of what might be done. The records collected are either not used sufficiently by the breeders themselves, or are considered so expensive a luxury that breeders, with their eyes on costs, cannot afford to take them. Score card systems of judging carcase qualities can be applied; but so far are used only on a very limited scale. Yet other countries provide striking examples of the ways in which productivity measures have been successfully used in formulating and giving impetus to development.

The requirements and aims of the commercial breeder and the pedigree breeder should be more closely integrated towards an organization of the industry; whether this organization should be imposed from without, or grow up within the industry, is as yet an open question. However achieved, it should allow for a greater specialization of function within breeds and for commercial production based upon deliberate cross-breeding; for example, those interested in the coloured breeds might specialize in mothering ability, adapted for outdoor methods of husbandry; while those concerned with the Large White breed should pay particular attention to growth-rate and carcase quality.

Even so, the present pedigree system requires close examination. The average size and duration of a pedigree herd are insufficient to allow scope or time for any definite breeding policy. Dr. H. P. Donald showed that an average herd lasts only for three years, while the average number of daughters of a sire in use is two; and a family system of breeding, such as could be genetically useful, exists only in names. Moreover, the industry now relies on relatively few people for the supply of good breeding stock; according to Dr. Hammond, nine tenths of the so-called pedigree breeders are just multipliers of pedigree stock. Whether such a system is adequate or even suitable as a vehicle for real improvement is doubtful. In any event, the question of responsibility remains.

The discussion around this aspect was somewhat diffuse; but the conclusion emerged that just as it is ultimately a State responsibility to encourage the ndustry towards progress on a defined cost structure nd production aim, so also is it a State responsibility to stimulate the accumulation of the necessary nformation on performance, and on genetic principles upon which sound breeding and selection olicies can be based.

J. E. NICHOLS.

RESEARCH IN THE U.S.S.R. ON CONDITIONED REFLEXES

RECENT work on conditioned reflexes from Pavlov's laboratory is published in *Trudy hysiologitcheskikh Laboratorii Pavlov*, 11 (Moscow, 944). The director of the laboratory is now Prof. . S. Kupalov, and, in general, work has proceeded long the lines initiated by Pavlov.

Considerable attention is being paid to the different types of 'neural personality' to be found among dogs. Not only is this a major factor in the production of xperimental neuroses, but also, as is now realized, t enters into the interpretation of all the ordinary physiological results. The primary distinction is between the 'strong' type of nervous system in which onditioned reflexes are readily and strongly developed, and the 'weak' type in which the reflexes are developed with more difficulty and easily extinguished. Either type may be unstable or 'unbalanced'. V. K. Fedorov finds that neuroses develop more readily in the weak type or in the strong unbalanced ype with deficient inhibitions. 'Strength' of the nervous system is reduced by castration and old age. Neurosis affects the whole nervous system, following a definite pattern which is determined by he order of stability of the established neural processes, and is independent of the mode of causation.

L. V. Vassilieva and I. S. Rosental have made an extensive study of tactile discriminations. They have been particularly interested in the discriminaion between symmetrically opposite points of the body, which is the most difficult tactile discriminaion to establish and varies greatly in the different neural types. They have also succeeded in developing a reflex in which the dog holds out its right paw and left paw alternately; this is probably the most omplicated conditioned reflex yet established. The main object of their work was to study the reciprocal relationships between symmetrically opposite areas of the cortex.

V. I. Pavlova finds that when the conditioned stimulus is prolonged into the period of the unconditioned timulus, the reflex is strengthened in the 'strong' ype of dog but weakened in the 'weak' type. V. K. Fedorov, by repeating a conditioned stimulus at successively shorter intervals and measuring the size of the response, found that after any one stimulation the cortical cells took 3–10 min. to recover their full excitability.

V. V. Yakovleva has continued the study of what Pavlov called the 'mobility' of nervous processes, which has to do with the speed and facility of development of excitation and inhibition. It has been shown that the chronaxie of all the voluntary muscles undergoes certain quantitative changes during the development of a conditioned reflex, and E. A. Yakovleva finds that previous removal of various parts of the cortex upsets or abolishes these changes; she concludes that the cortex as a whole, rather than any one particular part of it, is responsible for these hanges in peripheral chronaxie.

CHEMICALLY STABILIZED PAPER CAPACITORS

ACCORDING to an article by D. A. McLean (*Bell Lab. Rec.*, **23**, No. 3; March, 1945), the addition of a small amount of anthraquinone to the impregnant with which the paper is treated has greatly extended the life of paper-insulated capacitors. Among impregnants, chlorinated diphenyl and chlorinated naphthalene have been used extensively. They resist oxidation and thermal decomposition, have high dielectric constant compared with mineral oil, and good electrical properties. At room temperatures, capacitors with paper dielectrics impregnated with these chemicals have a satisfactory life. At high D.C. potentials, however, and at temperatures from 50° to 100° C., rapid deterioration of the dielectric results. There is a number of compounds which substantially increase the life of capacitors on accelerated D.C. tests, when added in small amounts to the chlorinated impregnant. These stabilizers also maintain the leakage current during tests at low and relatively stable values in contrast with the rapidly increasing leakage current in unstabilized capacitors. Among the stabilizers used, the quinones were the most satisfactory, and of them, anthraquinone was chosen for commercial use owing to its high effectiveness, ready availability in pure form, low volatility and lack of toxicity.

Evidence of the diminution of electrode corrosion by anthraquinone was obtained by using capacitors in which the electrodes consisted of thin aluminium films evaporated on kraft paper before the unit was wound. In these capacitors, a small amount of corrosion of the electrodes entirely consumed the aluminium. Capacitors made with this paper were dried and impregnated in the usual manner and subjected to voltage while held at 100° C. The impregnating compound was then extracted and portions of the paper were photographed by transmitted light to show holes produced by the corrosion. The positive electrode was attacked rapidly in the unstabilized capacitors, and eventually even the negative electrode showed deterioration. After testing for 240 hours at 300 volts, the anode was very largely destroyed. The stabilized samples, however, tested under the same conditions, showed no detectable attack of either electrode in 1,000 hours, or in 495 hours at 500 volts.

Suppression of deterioration of the dielectric and corrosion of the electrodes through chemical stabilization with anthraquinone is reflected in longer life and more stable leakage current. When a linen-paper capacitor impregnated with chlorinated naphthalene is subjected to continuous D.C. voltage at 100° C., the leakage current rises rapidly. Within a very few hours a failure develops which completely short-circuits the electrodes at some point. With 0·1 per cent anthraquinone in the impregnant, the current rises less rapidly, and the life is increased by about tenfold. Increasing the amount of stabilizer to the range of one-half to four per cent produces a relatively stable leakage current. The life is then about a hundredfold as great as when no stabilizer is employed. On the basis of these and other results, a minimum of 0·5 per cent is recommended for commercial use. Kraft paper exerts a stabilizing action of its own, and consequently kraft paper capacitors, when fortified with anthraquinone, are superior in performance to stabilized linen-paper capacitors.

FORTHCOMING EVENTS

Monday, October 15

United Nations Fellowship (at 29 Gordon Square, London, W.C.1), at 6.15 p.m.—Prof. N. Bentwich: "The Educational and Cultural Organization of the United Nations".

Association of Austrian Engineers, Chemists and Scientific Workers in Great Britain (at the new Austrian Centre Swiss Cottage, 69 Greencroft Gardens, London, N.W.6), at 7.30 p.m.—Dr. F. Eirich: "Modern Views of Colloid Science (with special reference to the Ultra-Centrifuge)".

Tuesday, October 16

British Society for International Bibliography (at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2), at 2.30 p.m.—Dr. S. C. Bradford: "Fifty Years of International Documentation" (Presidential Address); Discussion on "The Technique of making Abstracts of Scientific and Technical Papers" (to be opened by Eng.-Comdr. D. Hassie Smith, R.N.).

Eugenics Society (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Dr. W. Mayer-Gross: "Mental Health Problems in a Rural Area".

Sheffield Metallurgical Association (at 198 West Street, Sheffield 1), at 7 p.m.—Mr. J. E. Russell: "The Behaviour of Metals under Stress".

Wednesday, October 17

Society of Chemical Industry, Food Group (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Mr. D. W. Steuart: "The Nitrogen Content of Apple Juices and its Importance in Cider Making"; Mr. E. Ball: "The Raw Materials for Cider Making".

Institution of Electrical Engineers, Transmission Section (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. E. T. Norris: Inaugural Address as Chairman.

Institute of Fuel (at the Royal Geographical Society, Kensington Gore, London, S.W.7), at 6 p.m.—Prof. C. H. Lander: Melchett Lecture.

Institute of Welding, West Scotland Branch (at the Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow), at 6.30 p.m.—Mr. J. S. Blair: "Some Technical Problems in the Execution of 'Pluto'".

Thursday, October 18

Institution of Electrical Engineers (joint meeting with the Royal Meteorological Society) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Discussion on "Weather and Electric Power Systems" (to be opened by Mr. J. S. Forrest, Mr. H. W. Grimmitt, Mr. A. J. Drummond and Wing-Comdr. R. M. Poulter).

Royal Society of Tropical Medicine and Hygiene (at Manson House, 26 Portland Place, London, W.1), at 8 p.m.—Dr. C. M. Wenyon, F.R.S.: "Tropical Medicine in War and Peace".

Friday, October 19

Physical Society (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 5 p.m.—Prof. Bengt Edlén: "The Spectral Structure of the Inert Gases". (Fellows of the Royal Astronomical Society are invited.)

Institution of Mechanical Engineers (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Prof. Andrew Robertson, F.R.S. (Presidential Address).

Institute of Physics, Scottish Branch (joint meeting with the Industrial Radiology Group) (at the Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow), at 6.30 p.m.—Mr. E. Thomas: "The Radiography of Welds in High Pressure Steam Pipes".

Saturday, October 20

Royal Institute of Chemistry, London and South-Eastern Counties Branch (at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1), at 2.30 p.m.—Discussion on "The Publicity of Science, with particular reference to Chemistry" (Dr. O. J. R. Howarth, O.B.E., Mr. C. F. Brown, Mr. G. A. Jones, and others).

Institution of Mechanical Engineers, Graduates' Section (at Storey's Gate, St. James's Park, London, S.W.1), at 3.30 p.m.—Mr. R. Gore: "A System of Production Control".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Lecturer in Chemistry at the Widnes Municipal Technical College—The Clerk to the Governors (Oct. 15).

Technical Laboratory Assistant in the Chemistry Department, University College of South Wales and Monmouthshire, Cathays Park, Cardiff—The Registrar (Oct. 16).

Senior Lecturer in Civil Engineering—The Principal and Clerk to the Governing Body, Wigan and District Mining and Technical College, Wigan (Oct. 18).

Junior Assistant Physicist (temporary) in the London County Council's Hospitals Service—The Medical Officer of Health (S.D.6), London County Council, County Hall, London, S.E.1 (Oct. 19).

Lecturers in Mechanical Engineering, Production Engineering, and Physics in the Chance Technical College—The Chief Education Officer, 215 High Street, Smethwick (Oct. 20).

Lecturer in Mechanical Engineering at the Brighton Technical College—The Education Officer, 54 Old Steine, Brighton (Oct. 20).

Assistant Lecturer in the Mathematics Department—Th Clerk and Treasurer, Technical College, Bell Street, Dund (Oct. 22).

Two Highway Engineers (Ref. No E.1988.A), and Railwa Engineer (Ref. No. 1989.A), for service in China with the Unite Nations Relief and Rehabilitation Administration—The Ministry Labour and National Service, Technical and Scientific Register, Roo 670, York House, Kingsway, London, W.C.2 (Oct. 22).

Laboratory Technician (Public Health Department) with knowledge of Public Health Bacteriology (including milk examin tions) and/or Clinical Pathology, and a Technical Assistant (Boroug Engineer's Department) for work on repairs to war-damaged houses The Town Clerk, Finsbury Town Hall, Rosebery Avenue, Londo E.C.1 (Oct. 23).

Graduate in Chemistry in the Senior Science Department of th Southport Technical College—The Chief Education Officer, 1 Eas bank Street, Southport (Oct. 25).

Principal of the County Technical College, Guildford—Th Chief Education Officer, County Hall, Kingston-upon-Tham (Oct. 26).

Records Officer to the Nuffield Health and Sickness Recor Bureau, for the supervision of collection and analysis of informatio concerning morbidity in the West of Scotland—Mr. R. Morriso Smith, 135 Buchanan Street, Glasgow, C.1 (Oct. 27).

Lecturer in Chemistry, with qualifications in Inorganic Chemist and Metallurgy—The Principal, Heriot-Watt College, Edinburg (Oct. 29).

Assistant Chief of Research by firm in N.W. England engage in a highly technical form of manufacture on a large scale—Th Ministry of Labour and National Service, Appointments Departmen Technical and Scientific Register, York House, Kingsway, Londo W.C.2, quoting F.4367.XA (Oct. 29).

Inorganic Chemist (qualified) to supervise chemical control Middlesex factory manufacturing cast plaster panels—The Minist of Labour and National Service, Appointments Department, Technic and Scientific Register, Room 670, York House, Kingsway, Londo W.C.2, quoting F.4964.XA (Oct. 31).

Assistant to Head of Technical Engineering Departme of large Iron and Steel Works—The Ministry of Labour and Nation Service, Appointments Department, Technical and Scientific Registe Room 670, York House, Kingsway, London, W.C.2, quoting C.2683XA (Oct. 31).

Technical Assistant in the Department of Chemistry—The Registrar, The University, Bristol 8 (Oct. 31).

Biologist and a Physicist at the North-Eastern Forensic Scien Laboratory at Wakefield—The Establishment Officer, (Room 321 Home Office, Whitehall, London, S.W.1 (Nov. 6).

Engineers for development, indoctrination, and contact work lubricants field: (a) A.M.I.Mech.E., and preferably with University de gree, also experience with automobile firm (Reference No. C.2785.XA (b) A.M.I.Mech.E., and preferably with University degree, also ex perience in oil engine design and operation (Reference No. C.2786.XA (c) A.M.I.Mech.E., and preferably with University degree, also ex perience with steam power plant and general industrial engineerin (Reference No. C.2784.XA), (d) A.M.I.Mar.E., and preferably wit University degree, also experience with marine diesel manufactur (Reference No. C.2783.XA)—The Ministry of Labour and Nation Service, Appointments Department, Technical and Scientific Registe Room 670, York House, Kingsway, London, W.C.2, quoting appr priate Reference No. (Nov. 12).

Research Officer, Dairy Research Section, Council for Scien tific and Industrial Research, Melbourne—The Secretary, Australia Scientific Research Liaison Office, Australia House, Strand, Londo W.C.2 (Nov. 12).

Senior Lecturer in General Science and Scientific Metho in the University of Melbourne—The Secretary, Universities Burea of the British Empire, c/o University College, Gower Street, Londo W.C.1 (Nov. 15).

Professor of Physics—The Registrar, University College, Singleto Park, Swansea (Nov. 17).

Hackett Professor of Agriculture in the University of Weste Australia—The Agent-General for Western Australia, Savoy Hous 115 Strand, London, W.C.2 (Nov. 30).

County Surveyor to the Devon County Council—The Clerk t the Council, The Castle, Exeter, endorsed "Appointment of Count Surveyor" (Dec. 31).

Lecturer in the Department of Physiology—The Secretary, The University, Aberdeen (Jan. 15).

Professor of Geology, and a Professor of Industrial Chem istry, in the Farouk I University, Alexandria—The British Coun (Appointments Department), 3 Hanover Street, London, W.1.

Two Assistants in Agricultural Entomology in the Adviso Entomological Department, School of Agriculture, Cambridge—F. Petherbridge.

Officers (2) for the Intelligence Section of the Minera Resources Department, Imperial Institute—The Establishme Officer, Imperial Institute, South Kensington, London, S.W.7.

Trained Technician in the Physiology Department, an Demonstrators (temporary) in Physics, Biology and Chemistry—The Vice-Dean, St. Bartholomew's Hospital, at Queen's Colleg Cambridge.

Lecturer in Bacteriology in the University of Queensland—The Agent-General for Queensland, 409 Strand, London, W.C and the Secretary, Universities Bureau of the British Empire, c/ University College, Gower Street, London, W.C.1.

Teacher of Physics and Chemistry to first M.B. and Intermedia Science standard—The Principal, Technical Institute, Folkestone.

Lecturers in the School of Engineering for Mechanic Engineering and Electrical Engineering—The Principal, Leicest College of Technology and Commerce, Leicester.

Qualified Production Engineer, and a Teacher (man or woma of Biology—The Clerk to the Governors, Wolverhampton a Staffordshire Technical College, Wolverhampton.

NATURE

No. 3964 SATURDAY, OCTOBER 20, 1945 Vol. 156

CONTENTS

Page
Science and National Defence 457
Wilhelm Dilthey. By Dr. A. D. Lindsay, C.B.E. . . 461
A Flora of Familiar English Plants. By Prof. F. J. Lewis . 461
Steam Tables and Steam Power. By Dr. H. Heywood 462
Lognormal Distributions. By Prof. J. H. Gaddum, F.R.S. 463
New Views of the Origin of the Solar System. By Prof. W. H. McCrea 466
Reactions at Interfaces and their Significance in Biology. By Dr. J. F. Danielli 468
Obituaries :
  Prof. Ernest Shearer. By Prof. J. A. More . . 470
  Mr. L. E. Adams. By Dr. A. T. Hopwood . . 470
News and Views 471
Letters to the Editors :
  Can the Iron in Peroxidase be Replaced by Manganese ?—Prof. Hugo Theorell . . . 474
  Vitamin C Peroxidasic Activity.—Dr. N. Bezssonoff and Dr. Hélène Leroux 474
  Hæmoglobin in Blood-sucking Parasites.—Prof. H. Munro Fox, F.R.S. 475
  Œdema in Hamsters Infected with *Leishmania*.—L. C. Goodwin 476
  Production of *p*-Aminobenzoic Acid by the Tubercle Bacillus.—Torsten Ekstrand and Bertil Sjögren . 476
  A Theory of the Formation of Hydrochloric Acid in the Gastric Mucosa.—Prof. E. J. Conway, O. FitzGerald and D. Walls 477
  A Neutral Solvent for Melanin.—A. J. Lea . . 478
  Control by D.D.T. of Flies Breeding in Percolating Sewage Filters.—T. G. Tomlinson . . . 478
  Use of Hydrochloric Acid for Softening Algal Tissues for Microtome Sections.—Dr. Kathleen M. Drew (Mrs. Baker) 479
  Activation Energy of Ionic Migration in Molten Salts.—Dr. E. Heymann and H. Bloom . . 479
  Dielectric Constants of Some Titanates.—Dr. B. Wul 480
  A Photographic Method of Deriving Isoclinics in Photo-elastic Methods.—B. Dunn . . . 480
ociety for Applied Bacteriology 481
ritish Electrical Engineers and the War 482
cientific Study of Fellmongering. By Dr. D. Jordan Lloyd 483

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SCIENCE AND NATIONAL DEFENCE

THE debates in both Houses of Parliament on the Charter of the United Nations on August 22 and 23 showed how widely it is realized that the secret of the atomic bomb cannot be kept indefinitely by any one nation, and that the only alternative to pooling knowledge is a further competition in armaments research of a new type which must inevitably plunge the world into disaster. The Lord Chancellor very rightly said that to try to keep the secret would encourage research in the methods of destruction in every country of the world. The debate further demonstrated that the Government is endeavouring to formulate a rational policy towards the new development, and that the new policy must be based on the full and free exchange of fundamental scientific knowledge. As Prof. Niels Bohr has pointed out, no control can be effective without free access to full scientific information. President Truman has, in effect, lent his support to that same condition by his executive order of August 27, calling for the earliest possible release and free dissemination of scientific and industrial information gained from Germany and Japan. This order covers all information concerning scientific, industrial and technical processes and inventions, in enemy countries or in liberated areas, if such information is of enemy origin or has been acquired or appropriated by the enemy. This means that the details of Germany's experiments with atomic bombs will be shared and made public when the chiefs of staff decide that it is safe to do so.

While the full meaning of the order is perhaps open to question, it points to a situation which calls for an early meeting of the Powers to discuss the whole problem of atomic energy and its control. The pressure in the House of Commons debate for some form of international control in relation to research and to production and through a system of inspection, scarcely took account of the fact that no appropriate international authority yet exists, and that even the Security Council at present scarcely meets the requirements. Preliminary discussions between the United States, Great Britain, the U.S.S.R. and at any rate China could do much to prepare the way; the respite of two or three years will be none too much to elaborate the essential structure of the control and inspectorate required and to secure the approval and support of all the nations concerned.

Meanwhile, it is essential that there should proceed as a matter of urgency the full re-evaluation of the whole structure of the defence of Britain in the light of these considerations, and particularly of the means for watching and controlling new developments in the technique of scientific warfare. From this point of view the statement relating to the atomic bomb issued by the Department of Scientific and Industrial Research demands close study, and Lord Hankey's recent book is also opportune*. In the Lees Knowles Lectures which form the basis of his book, Lord Hankey gives a brief synopsis of the development of government machinery in Britain for the formulation and co-ordination of defence policy, from the establishment of the Committee of Imperial Defence at the beginning of the present century up to the delivery of the last lecture of the series on March 9, 1945. The basic principles he establishes and the lessons he draws for the future cannot be disregarded by any who seek to appraise the new situation. Although the fact could not be disclosed in his lectures, Lord Hankey had himself been in touch with many aspects of the development of the atomic bomb, and in a letter in *The Times* of August 11 he supplemented the official accounts in respect of the part played by the Scientific Advisory Committee of the War Cabinet in 1941.

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* Government Control in War. By the Rt. Hon. Lord Hankey. (Lees Knowles Lectures, 1945.) Pp. 90. (Cambridge: At the University Press, 1945.) 4*s*. 6*d*. net.

Lord Hankey's story will be to many people unexpectedly reassuring. Within the narrow interpretation of a defensive policy, both in 1914 and in 1939 our preparations were sounder, more thorough and complete than has been generally realized or believed, for all that, like the other peace-loving nations, the outbreak of war found Britain with armaments totally insufficient in numbers and efficiency to withstand the enemy. That unpreparedness resulted from a failure, not of our system of imperial defence, but of the political working of the constitutional system of Government by Parliament and people. This is the fundamental lesson, and Lord Hankey insists that the only real check on a recurrence of our past unpreparedness is the spread of greater knowledge and understanding among the people as to the importance of national defence.

The challenge of the atomic bomb at least presents us with an unrivalled opportunity for that task of educating public opinion as to what is involved, and raising the question of national defence above party politics. Lord Hankey in his concluding lecture appealed specially to the universities to play their part in the task of promoting a better understanding of the lessons of history in their application to imperial defence; and the part which men of science have played in the development of the atomic bomb adds weight to Lord Hankey's emphasis on the responsibility even of undergraduates in this matter. Speeches in the House of Commons and correspondence in the daily Press provide abundant evidence of the work yet to be done to build up a sound and healthy public opinion, and combat the shallow, if not thoroughly unsound, thinking on national service and like issues that has already found expression.

The first governing principle laid down by Lord Hankey, that final control must remain in the hands of statesmen, working in the closest co-operation with the Service chiefs, with the Prime Minister of the day alone as head, was in fact firmly asserted by Mr. Bevin when he stated that he is not prepared to see control of the atomic bomb handed over to the military authorities at all. Control is the responsibility of the Government, and military authorities must remain the Government's advisers. Again, Lord Hankey points out that, while in the grand strategy of the War the views of the Service chiefs must usually prevail, even here the last word must rest with the statesmen, who are responsible for policy and for distributing the resources of the country in the manner best calculated to win the war. Relations between statesmen and commanders-in-chief should be conducted on the principle of selecting the best men available, giving them a free hand, and backing them up to the hilt with a minimum of interference. Governments are entitled to ask their commanders-in-chief to consider alternative plans to their own, but should rarely ask them to carry out plans in which they do not believe. In time of peace, the Prime Minister, whether with or without a deputy, but in association with some of his colleagues, should always be responsible for, and well acquainted with, our preparations for war.

It is because, as Lord Hankey shows, these principle were observed very closely in practice by Mr. Asquith and Mr. Lloyd George in the First World War, and by Mr. Chamberlain and Mr. Churchill in the Second World War, and that for forty years our Prime Ministers, as presidents of the Committee of Imperia Defence, have been responsible for preparations fo war, that it can be claimed that we in Britain hav evolved a system which is superior to that of ou enemies or of any nation in the previous history o war. Lord Hankey not only pays a handsome tribut to Mr. Lloyd George as the founder of our moder system of control; he also maintains that ou administrative preparations in 1939 were as complet as they could be, within the limits of our policy an the finances made available; and while he prefer on the administrative side the more flexible syste adopted in 1916–17, he insists that our chiefs-of-sta organization to-day is the best example the worl has ever known of a great joint general staff t cover and combine all aspects of inter-Service operations. We already possess a Combined General Staff and in a form which permits rapid transformatio from a war system to a peace system and vice versa

As to methods, Lord Hankey concludes that th most successful form of administrative control is tha initiated by Mr. Lloyd George: a small War Cabine composed of a few Ministers of great experience, som at least of whom are free from departmental or heav Parliamentary duties and able to give their whol time to the central problems of the war and to lif some of the weight off the Prime Minister. Furthermore, Lord Hankey suggests that as a matter of overriding principle, the Prime Minister must have th system and organization that his methods and temperament and the circumstances of the times requir Machines are made for men and not men for machine and in urging generally the need of flexibility so tha the system is adaptable to different temperamen and circumstances, Lord Hankey attributes th success of our present system largely to its flexibilit

That flexibility is attested by the development the Directorate of Tube Alloys described in the rece paper of the Department of Scientific and Industri Research. Indeed that statement in itself might we be taken as a striking testimony to the adaptabilit of our existing system. Lord Hankey's long experience largely endorses some of the observatio in the final report of the Select Committee on Nation Expenditure for the Session 1944–45; but althou it is not in accordance with the principles that he enunciates to place on scientific men as such the executive responsibilities which Dr. Haden Guest suggested, Lord Hankey, like the Select Committee, considers that further measures are required to secure in future a much greater use of science in all its branches. It is understood that the Office of Scientific Advisers to the Ministry of Production has already been allowed to lapse, and this step should not be allowed to pass unchallenged. A most important part of the central system in Britain, Lord Hankey considers, should be a strong scientific and engineering section to watch all developments in physics, chemistry, explosives, civil, mechanical, electrical and chemical engineering, metallurgy, biology, nutrition, medicine, etc., from the point of view of their possible use by an enemy and by ourselves; to plan the measures to be taken to neutralize new developments, and to lay out research. Scientific work on defence accordingly should now be brought to the centre and coordinated by a special organization attached to the Committee of Imperial Defence. This might include a small directing committee, on the lines of the existing Scientific and Engineering Advisory Committees, with a large panel of consultants and a secretariat of whole-time specialists. Each Government department concerned in imperial defence would have its own scientific division as at present, closely linked with the central body; and, like the Select Committee, Lord Hankey refers to the need for organizing scientific workers in advance for war emergency, and for including in our war arrangements plans for expansion and for training the large numbers required.

Whether the Select Committee was aware of the atomic bomb preparations or not when preparing its report, such developments were clearly in Lord Hankey's mind in delivering these lectures, and scientific workers would have welcomed a much fuller discussion of the scientific aspects of defence policy and organization than the page or so they receive in this book. Moreover, while Lord Hankey's letter to *The Times* was concerned to pay tribute to the part played by the Scientific Advisory Committee and to the collective influence of Sir Henry Dale, Prof. A. V. Hill, Sir Alfred Egerton, Sir Edward Appleton and Sir Edward Mellanby prior to the establishment of the Directorate of Tube Alloys of the Department of Scientific and Industrial Research, neither there nor in his book does he touch on the larger question of the combined chiefs of staff organization or the practicability of international control. These, however, are the major points of concern at the moment. The atomic bomb itself is the outcome of a remarkable demonstration of co-operative research and enterprise between the scientific workers of Great Britain, the United States and Canada, with others of the United Nations. What is in dispute is the practicability or otherwise of devising a system of co-operative international control.

As has already been noted, no international authority yet exists to which the exercise of control could be entrusted: the Security Council, as at present constituted, would in practice merely mean entrusting the responsibility to Great Britain, the United States, the U.S.S.R. and a few other Powers, and the proposal might or might not be acceptable to other members of the United Nations. Meanwhile, however, it is essential that the full implications of the situation should be brought out; and either international control dismissed as impracticable for reasons clearly given, or a scheme worked out which will satisfy the essential conditions, even if the ultimate repository of the control yet remains to be determined.

Brigadier J. L. P. Macnair, referring to the leading article in *Nature* of July 14, has suggested that the Security Council should have at its disposal an armaments development department, staffed by scientific men and service officers of all nations and equipped with all the resources necessary to keep abreast of the results flowing from basic research. It should be in the power of the Security Council, on the advice of this department, to call on any nation for details of technical advances in war-like stores, and refusal to comply with such a request should be regarded as evidence of intended aggression. If the Council succeeds in establishing a reputation for impartiality, such details would probably be readily made available in the cause of peace, certainly up to a time sufficiently close to that of a threatened aggression for the armaments development department to keep abreast of the work, using its own resources.

It may, of course, be maintained that secrecy in the development of full-scale experimental equipment for the manufacture of any new weapon of war is still possible, and this objection applies equally to any proposals for the control and international inspection of the armaments industry as a whole. On the pessimistic view, international control of research into atomic energy would mean nothing; any powerful nation with a large hinterland could break the convention, leaving out of account the possibility of further developments.

Sir Arthur Salter, who in the debate urged that the military provisions of the Charter have become obsolete in the light of this new weapon unless we succeed in controlling it effectively, stressed the factor of speed, and did not minimize the difficulties in achieving adequate control. Like Prof. Niels Bohr, he recognizes that control measures may demand the abolition of barriers hitherto considered necessary to safeguard national interests, but now standing in the way of common security against unprecedented dangers. Sir Arthur thinks it may involve some restriction of research that may be distasteful to all the traditions of science. Research on atomic energy, he believes, will have to be conducted under conditions of public scrutiny which will take adequate steps at every stage to control its application. Regarding the Atomic Energy Advisory Committee as a first step in this direction, he suggested that the secret of the atomic bomb should only be shared as a counterpart to an assured international control in each country which is given possession of the secret.

Sir Arthur is thus thinking on similar lines to Sir John Anderson, who has already stated that the essential features of such a control are, first, an undertaking by each nation to submit all relevant information in its possession to a central authority having unrestricted rights of inspection, and secondly, the possession by such central authority of the means of enforcing the undertaking against any recalcitrant nation. Such an international and predominantly foreign control in each country of the most important weapon of war clearly runs counter to every national prejudice and tradition, and the handling of this precarious situation will demand the utmost goodwill of all nations. Could agreement be reached, however, the contribution it would make to the removal of obstacles to mutual confidence and the promotion of harmonious relations would be incalculable.

The House of Commons was clearly fully alive to the dangers of attempting to preserve secrecy. Mr. Price pointed out that a barrier between the Great Powers of the Security Council in military secrecy and scientific research would intensify political barriers, and might lead to division into two camps rigorously guarding their military secrets and scientific inventions, in complete contrast to the spirit of free inquiry, untrammelled by secrecy, relentlessly searching after truth, which is the mainspring of science. Nor was it forgotten that the Charter establishes no effective international authority, and that we are still faced with the task of creating an instrument of unchallengeable power which at the same time will secure liberties under the reign of law that men will make great sacrifices to maintain. Mr. Boothby pressed very strongly for the establishment of a scientific section of the Economic and Social Council; but while Mr. Bevin, in winding up the debate, added very little to what had been said, his speech indicated that the Government is viewing the whole question realistically and in the right perspective.

We have to consider control, said Mr. Bevin, not merely of the atomic bomb but also of the whole advance of science in the field of war, and it is the aim of the Government, through the world organization, to eliminate the desire to exploit the discoveries of science for the purposes of war, and turn them into channels which will serve human welfare. Consideration of disclosure of the secret of the atomic bomb should be postponed until the world organization is established and the whole question of control of dangerous weapons can be discussed, including that of the essential raw materials. So far as it is necessary to implement the work of the world organization to control scientific research or the manufacture of weapons, we should endeavour to direct our policy so that such weapons become unnecessary, and keep a careful watch to ensure that no Government starts out with war-like intentions.

The debate on the United Nations Charter clearly affords no ground for undue optimism as to the achievement; nevertheless it was recognized that science itself is not to be blamed for the prostitution of scientific effort in such developments as the atomic bomb, and speaker after speaker referred to the necessity for a moral basis for the new effort to achieve world order and international control. Man's intellectual and scientific attainments have far outdistanced his achievements in the moral sphere, and even if there is built up in an international technical inspectorate a tradition, as Dr. J. B. Conant has suggested, in which professional loyalties are anchored to the United Nations, control will still be ineffective without some advance in the whole standard of national and international morality which will accept the sacrifices of national independence involved.

That must be largely a matter of creating an informed public opinion, such as Lord Hankey stipulates and to which Mr. Bevin also referred in the close of his speech. The Government is clearly moving along the right lines, and the statements relating to the atomic bomb should do something to assist in this fundamental task of educating public opinion in this vital matter. More might well be done by the appointment of a committee to consider appropriate means of parliamentary control of public expenditure on research, as recommended by the Select Committee on National Expenditure; and it is to be hoped that these new developments will lead the new Parliament to give close attention to this whole question of research and development as recommended in the final report for last session of that Committee

The challenge to scientific workers in the debate as in Lord Hankey's book, is unmistakable. If the broad structure of the nation's organization for defence is on right lines, there are still ways in which it can be further improved, and the full contribution of science in national defence facilitated and made more effective. Besides criticisms from the Select Committee on National Expenditure, there are wise suggestions made by Prof. A. V. Hill to the Parliamentary and Scientific Committee for breaking down departmentalism and the traditional secrecy of science in the Services, and bringing the departments into closer touch with the wide horizons and most recent developments in science which are still pertinent.

But Lord Hankey's reminder of the special responsibility which lies upon the man of science in the task of forming an educated public opinion has been reinforced by a noble appeal from Prof. Niels Bohr. The scientific man, more than most men, is in a position to appreciate the constant and dire peril of civilization unless some effective international control can b devised and operated. On him must fall, too, some measure of responsibility for devising and operating that control. He knows that the march of scienc cannot be stopped, and that the foundation for any international control must be full and free interchange of fundamental scientific knowledge. He may indee never have a more favourable opportunity of pressin for the removal of all the restrictions that in the las thirty years have been imposed upon such communications. But he knows, too, the truth of General MacArthur's words at the Japanese surrender ceremony, that man needs a growth in his spiritual powers to equal the almost matchless advance in science; scientific workers are prepared to assist in any way possible to solve the present crisis of humanity in a manner worthy of the ideals for whic science through the ages has stood. The first practical step to that end must be the establishment of full freedom of communication and dissemination of knowledge.

WILHELM DILTHEY

Wilhelm Dilthey

An Introduction. By Prof. H. A. Hodges. (International Library of Sociology and Social Reconstruction.) Pp. x+174. (London: Kegan Paul and Co., Ltd., 1944.) 10*s.* 6*d.* net.

As Prof. H. A. Hodges says in the beginning of his introduction, this is the first book on Wilhelm Dilthey to be published in England, and it is overdue. Why Dilthey did not attract attention in England earlier is puzzling. The reason is possibly that the most interesting parts of his work only appeared after his death in 1911. Eleven volumes of "Gesammelte Schriften" came out between 1914 and 1936. The challenging "Einleitung in die Geisteswissenschaften" ("Introduction to Human Studies", as Prof. Hodges translates it) was indeed published so long ago as 1883, but that remarkable work is more the statement of a problem or a challenge than an answer.

Still, the challenge was one which should have been taken up in Britain. For in that book, Dilthey shows that what is wrong with the *Geisteswissenschaften*—human studies—is that it has been continuously assumed that they either ought to be sciences like physics or be philosophy. Quite obviously, he maintained, they are neither one nor the other. Attempts to reduce history to a natural science in the manner of Buckle or to reduce it to philosophy are equally ridiculous. It clearly has its own methods and its own standards.

Now that was very much a challenge to us. We had gone so far in Britain in the direction Dilthey deplores that we have no word corresponding to the German *Wissenschaft*—any systematic thorough discipline with approved methods and standards. Science means in English natural science. Our study of politics and morals has either been predominantly philosophical and therefore not sufficiently empirical or historical, or had its facts falsified to make them fit into an atomism impressed by the example of physics; it had to follow the example set by Hegel or by Bentham, the specific German or the specific English pattern. Karl Marx made a gallant attempt to unite these two sources; but the German and the Hegelian in him conquered the empirical.

Dilthey's attempt is more interesting and far more promising. He was a Kantian. He started with a firm belief in Kant's criticism of metaphysics. The side of Kant which attracted him was the empirical. He wanted only to consider historical studies with the same impartial scrutiny as Kant had given to physics. He held, and rightly, that the rise and progress of historical study in the nineteenth century was in its way as remarkable as the rise of physics before. He proposed in his thoroughgoing empiricism to take history as he found it; not to say it ought to be like physics or like philosophy, but to discover what it was. So he set himself to write a critique of historical reason to be set out against Kant's critique of pure reason.

Can one recognize that the understanding of human beings and society requires a certain imagination, a sympathy, a power of putting oneself in the place of others, which the understanding of the physical world does not, and yet give to this very different kind of understanding the systematic thoroughness and the objectivity of the physical sciences? That is Dilthey's problem. He never completed his critique of historical reason, but he wrote a great deal towards it. Prof. Hodges gives an admirable account of the conclusions to which he came: his far-reaching contributions to psychology and to sociology as well as to historical method.

As Prof. Hodges points out several times, there is considerable similarity between Dilthey's thought and that of the late Prof. Collingwood. There is, however, this important difference. Collingwood was a philosopher and historian. He was primarily interested in history, in which he was an authority, and not in the other human studies like psychology and economics. Dilthey recognized that mind and body, man and Nature, being so closely knit, the 'human studies' merge at one end of the scale into the natural sciences; but he always maintained that they must all be taken together. The inquiry which co-ordinates them all gives the *Weltanschauung* which is the goal of our understanding and must itself be one of the *Geisteswissenschaften* and follow their methods.

What is the final co-ordinating inquiry which will give what Dilthey calls the *Gesamtaufbau*? Is it sociology or history? Dilthey seems sometimes to have put one and sometimes the other of those two in pride of place. Prof. Hodges thinks that he should have come firmly down on the side of sociology. I should myself press the other alternative.

I hope I have said enough to show the extreme interest of the issues raised and the conclusions set forth in this long and masterly account of Dilthey's thought, supplemented as it is by selections from the most important of Dilthey's discussions. I hope the book will be widely read. A. D. LINDSAY.

A FLORA OF FAMILIAR ENGLISH PLANTS

Common Wild Flowers

By John Hutchinson. (Pelican Book A.153.) Pp. xxx+222+14 plates. (Harmondsworth and New York: Penguin Books, Ltd., 1945.) 9*d.*

This admirable little book should supply a long-felt want by all lovers of the English countryside. Handy in form and size, it can be carried comfortably on country rambles, and with its aid many of the wild plants found can be easily identified. As an experienced botanist Dr. Hutchinson brings a skilled experience in dealing with the identification of plants by those having no botanical knowledge.

The introduction deals briefly with the salient features of floral structure and then goes on to describe the use of the key. The key is divided into three sections dealing with the Gymnosperms, the Dicotyledons and the Monocotyledons respectively. These are very clear, and the layman should have no difficulty in determining the genus and species of any plant described in the book. The plants selected number 202, and these are well chosen and represent familiar plants most of which may be found on country rambles in almost any part of Great Britain. Only six Monocotyledons are listed; perhaps the number might have been extended by the inclusion of a few of the marsh plants so common in many parts of the country. Each plant has a page of detailed description and is accompanied by excellent drawings of the shoot, leaves, flower and floral structures, and in many cases the fruit and seed. These drawings are really well executed, and the reproduction is excellent. With all these aids set down by a skilled botanist, the collector should have no difficulty in running down a specimen.

But more is given than the botanical and popular name of each species, for the habitat in Great Britain and the distribution of the species abroad is described in many cases, and in dealing with trees the characteristics of the wood and the uses to which it is put are generally given. This is a most desirable feature, and gives the layman a glimpse into the interesting features of the varied distribution of plants over the surface of the earth. In addition to the illustrations attached to each species, twelve pages of photogravures are added of some well-known plants such as the foxglove, cowslip, sweet violet. These are well reproduced; but it is a question whether this space might not have been devoted to the description of twelve more species.

Many features of biological interest are frequently introduced, as in the case of the behaviour of alder seeds after shedding. Such features make the book so much more than a mere list of plants.

This book, so well designed for its purpose, can do a great deal to promote an interest in plant life, and in many instances will lead on to the desire for a more extended knowledge of the green mantle covering the earth, whether it be in the direction of geographical distribution or the grouping of different kinds of vegetation in different parts of the country. For the reader who, after practice with this book, desires to extend his knowledge to other plants of Britain a short list of books is given.

Besides appealing to the layman interested in natural objects it should be of value in the schools. Some knowledge of classification and of plants in their natural habitat is of fundamental importance, and unfortunately it is an aspect of botany which in many British universities is treated in an inadequate fashion.

There is need for similar books on geology constructed on a regional basis, so that a general knowledge of earth structure and its varied plant cover may become a common possession of all educated people.

F. J. LEWIS.

STEAM TABLES AND STEAM POWER

The 1939 Callendar Steam Tables

Compiled and edited by G. S. Callendar and A. C. Egerton. (Published for the British Electrical and Allied Industries Research Association.) Second edition, with New Appendix on Properties of Compressed Liquid Water. Pp. 70. (London: Edward Arnold and Co., 1944.) 12*s.* 6*d.* net.

THE successful design of improved steam power-cycles utilizing high pressures and temperatures depends entirely on an accurate knowledge of the properties of steam. An increase in the efficiency of the steam cycle by 1 per cent represents a large annual saving in the coal cost for a modern power station; but this degree of accuracy in the calculations can only be attained if the tabulated properties of steam at extended pressures and temperatures are reliable. Practical evidence was obtained of the inaccuracy at high pressures of the earlier steam tables when high-pressure boilers were first constructed, for the calculated heat transferred to steam plus the measured losses in the boiler was greater than the heat supplied by the fuel. Since the losses in a modern boiler are small, and can be measured with a high degree of accuracy, it was clear that the tabulated total heats of steam were greater than the true values.

The work of the late Prof. H. L. Callendar is outstanding in the measurement of the properties of steam, and this research has been continued by Mr. G. S. Callendar and Sir Alfred Egerton, with the support of the British Electrical and Allied Industries Research Association. Research has also been conducted in the United States and on the Continent, with close co-operation between the investigators and the holding of three international conferences.

The following table has been compiled in order to compare the values of the total heat of saturated steam at various pressures as quoted by several investigators.

TOTAL HEAT OF DRY SATURATED STEAM ABOVE WATER AT 32° F. IN B.TH.U. PER LB.

Investigator and date	Pressure in lb. per sq. in. absolute 1	15	200	500	1000	2000	3000
Mollier, 1906	1103·3	1152·1	1205·6				
Marks and Davis; 1909 and 1922	1104·4	1150·7	1198·1	1210·0			
Callendar; 1915* and 1924	1102·4	1151·2	1205·4	1222·2	1230 9	1232·3	
Mollier, translated by Moss; 1927†	1103·2	1151·3	1200·6	1202 0	1179 4	1112 9	1001·2
Callendar and Moss; 1931	1102·4	1151·2	1203·5	1213·2	1204·3	1148 8	1039 3
Knoblauch, Raisch, Hausen and Koch; 1932	1104·9	1151·0	1198·5	1202·7	1190·2	1135·1	1017·0
Keenan and Keyes; 1936	1106 0	1150·8	1198·4	1204·4	1191·8	1135·1	1020·3
Koch; 1937	1105·5	1150·3	1198·9	1205·1	1191·6	1135·1	1019·7
Callendar and Egerton; 1939	1106·0	1151·6	1199·6	1205·5	1192·9	1136·1	1016·4

* 1915 Tables limited to 500 lb. per sq. in. pressure.
† Based on additional data by Mollier and revised equations.

The general deductions which may be drawn from these above figures are as follows: (*a*) There is a slight increase in the total heat values for steam at low pressures below atmospheric. (*b*) Little change has occurred in the total heat values of steam at atmospheric pressure. (*c*) There is a decrease in the total heat values for high-pressure steam amounting to about 3 per cent at 1,000 lb. per sq. inch and to 8 per cent at 2,000 lb. per sq. inch. (*d*) Since 1932 the values over the whole range of pressure are sufficiently in agreement for practical design purposes, and within the limits of tolerances set by the Third International Steam Table Conference, 1934.

In connexion with this comparison, it should be noted that the Callendar 1939 values are based on actual measurements of total heat, whereas other tables are based on values deduced from specific heat and volume measurements. The fact that the two systems of determination are now in substantial agreement indicates that the recently published properties of steam cannot err greatly from the true values.

The numerical values in the second edition of the Callendar 1939 Tables are unaltered from those in the first edition of these tables; but a new appendix on the properties of compressed liquid water at high pressures and temperatures has been added. These tables are the result of much careful research and planning, and should meet the requirements for many years of engineers concerned with the design and testing of steam power plant or of heating and ventilating systems.

H. HEYWOOD.

LOGNORMAL DISTRIBUTIONS

By PROF. J. H. GADDUM, F.R.S.
University of Edinburgh

A LARGE part of statistical theory is based on the assumption that measurements are distributed in normal probability curves and that the variance is constant. The normal curve was discovered by de Moivre in 1753 and developed as a useful mathematical tool by Laplace, Gauss, Maxwell and others. It has a number of interesting properties, and various attempts were once made to establish a law of Nature known as the 'normal law of errors', which implied that measurements ought always to be distributed in this way. These attempts were undeservedly successful. The use of the adjective 'normal' in connexion with this law implies more than is justified by the facts, whereas in fact the adjective is established by custom and provides a convenient label for distributions of this type.

Referring to the normal law in the introduction to his "Thermodynamique", H. Poincaré (1892)[1] quotes the remark that "Everybody firmly believes in it because the mathematicians imagine it is a fact of observation, and observers that it is a theory of mathematics". Since that time the mathematical conditions for normality have been firmly established[2], but the best evidence that these conditions are fulfilled in any particular case is still the observation that the distribution actually is normal. It is therefore important, either to show that observations are normally distributed, or to convert them into a form which is normally distributed, or at least has the best possible chance of being normally distributed.

In some cases the normal curve gives a very close approximation to the observed facts. These cases are the exception rather than the rule; but it is usually possible to transform the distribution by means of some function of the actual observations which is normally distributed, so that if this function is used instead of the observations themselves the subsequent calculations are simplified and their scope is extended. This device is well known to statisticians, but not used so widely as it should be. It is obviously justified in simple cases. Suppose, for example, that the original observations were measurements of the diameters of drops in an emulsion (d) and that it was found that the distribution of d was not normal, but that the distribution of d^3 was normal. This would mean that the volume of the drops was normally distributed, and would show that it would be more convenient to consider the distribution of volumes than the distribution of diameters. The size of the drops can, in fact, be measured in a number of different ways. There is no particular reason why the original observations should represent the most convenient way, and no particular reason why the most convenient way should not be used even if it is less obviously reasonable than in the example given above.

"The linear scale, since it was first cut on the wall of an Egyptian temple, has come to be accepted by man almost as if it were the one unique scale with which Nature builds and works. Whereas it is nothing of the sort" (Bagnold[3]).

Even if one method of measurement gives normal distributions, it necessarily follows that most others will not; and since it is unlikely that the appropriate method will often be chosen first, it is only to be expected that most distributions will not be normal unless care is taken to select the appropriate method of measurement[4].

The second condition for the unfettered use of statistics is that the variance of the distribution shall be constant, or at least shall vary in some predictable way. If these two conditions are fulfilled, it is easy to calculate the significance of differences, regression lines, correlation coefficients, the analysis of variance and so on; but, if not, the possibilities are very restricted. For example, if the distribution is not normal, it is unjustifiable even to assume that the arithmetic mean is the best estimate of a quantity that can be derived from a set of measurements of it. Recent developments in statistical technique have thus greatly increased the importance of methods for normalizing distributions by altering the method of measurement, or by transformation of each observation by some suitable device such as taking its logarithm. This is particularly important when the standard deviation is large compared with the mean. When it is small, all ordinary transformations of this kind have less effect, and in the limit when it is very small no such transformation has any effect at all.

The theoretical justification for using normal curves depends on the mathematical fact, which is true within certain defined limits[2], that the sum, or arithmetic mean, of a large number of variables tends to be normally distributed even when the individual variables are not. If an observation (x) depends on the sum of the effects of a large number of small causes acting at random, and if each effect is independent of x, the distribution is likely to be normal. If it is not normal, we assume that this is because x is not measured in the right way. We find that $f(x)$ is normally distributed and we therefore transform our observations of x by converting them into observations of $f(x)$. The normal shape of the distribution of $f(x)$ is presumably due to the random combination of numerous causes each of which has a small effect on $f(x)$, and this effect is independent of $f(x)$. The effect of each of these causes on x will be proportional to $dx/d\,f(x)$, and Kapteyn[5] calls this quantity the 'reaction'. For example, if $f(x) = \log x$, the reaction is x. The effect of each small cause on $\log x$ is independent of $\log x$ (and of x); its effect on x is therefore proportional to x. If x is an astronomical observation involving a reading on a dial, the absolute value of x is usually irrelevant; the reaction is likely to be constant and the distribution is likely to be normal. In most scientific observations, however, the absolute value of x is not irrelevant. A fine day which adds a given weight to a large animal is not likely to add the same weight to a smaller animal. The gains in weight are more likely to be proportional to the size of the animal. In other words, the effect of the fine day on the logarithm of the weight is more likely to be constant than its effect on the weight, so that the logarithm of the weight is likely to be normally distributed. The assumption that this will be so is not likely to be exactly true; but it is likely to give a closer approximation to the facts than the assumption that the effect is independent of the weight.

The problem has been tackled in a rather different way by Curtiss[6], who discusses methods of calculating the appropriate transformation from various assumptions regarding the relation between measurements and their standard errors, and comes to the conclusion that when the error is proportional to the measurement the use of logarithms is likely to produce normal curves.

Testing Transformations

It is usually necessary to discover the best method of normalization by trial and error. Standard statistical methods such as the calculation of goodness of fit and moments give the ultimate criterion of the success of any particular method of normalization, but a simple graphical method indicates at once not only which transformations are successful, but also in what ways other transformations fail.

This graphical method consists in first applying the appropriate transformation to the observations and then plotting the results as abscissæ either on probability paper, or against probits as ordinates. The probit is best defined in terms of the normal equivalent deviation (N.E.D.). The N.E.D. corresponding to any given percentage is calculated from the shape of a normal curve the standard deviation of which is one ; it is the deviation (from the mean) equivalent to the given percentage of the area of the curve. The probit is equal to the N.E.D. + 5. This is now a standard technique[7] and need not be discussed in detail. It has been widely used in experiments on toxicity, when the data are obtained as a relation between the dose of a drug and the percentage mortality which it causes[8,9]. Each mortality is converted, by means of tables, to a probit. If the animals vary in such a way that the dose (or transformed dose) is normally distributed, the probit should bear a linear relation to the dose (or transformed dose). It is usually obvious at once whether the plotted points are distributed at random about a straight line ; and, if they are, it is possible with practice to draw a straight line which fits the results well enough for most purposes. Regression lines may be fitted if necessary, and it is possible to obtain the solution giving maximum likelihood by a suitable technique using successive approximations, which was discovered after less satisfactory methods had been used[10]. Any regular tendency for the points to diverge from a straight line shows that the distribution is not normal, and how it differs from the normal curve. The reciprocal of the slope gives an estimate of the standard deviation when the line is straight, and is proportional to the 'reaction' at each point when the line is not straight.

The primary use of this graphical method is where the data are limited to the percentages corresponding to different values of the variable (for example, dose); but the same method is sometimes helpful even when fuller information is available. If n observations have been made of a given variable, one method is to arrange them in order of size and then allot to the smallest observation a percentage of $100/2n$ and to succeeding observations percentages of $300/2n$, $500/2n$ . . . $(2n - 1)100/2n$. These percentages are then converted to probits and each individual observation is plotted. If the data are numerous they are grouped and added cumulatively, and the probits are plotted against the points separating the groups. When the number in a group is very small it is best to plot individual readings, or to assume that the observations are evenly distributed in the range covered by the group. If straight lines are obtained the distributions are normal, and the mean and standard deviation can be estimated fairly accurately from the graph. When results are treated in this way, the usual technique for calculating a regression line is inapplicable. The best estimates of the mean and standard deviation will be obtained by applying the ordinary methods directly to the transformed observations, but in some cases they can also be estimated from the moments of the original distribution. This is likely to be the most convenient method when the original observations are grouped, but its scope is limited. Examples are given below.

The use of probits also provides a general graphical method of normalizing distributions without the use of any formulæ. This may be useful when the scale on which the results are measured is a purely arbitrary one. If a random sample of observations is plotted against probits and a smooth curve is drawn through the results, this curve may be used for converting subsequent observations to a scale of probits, which are, of course, normally distributed. It is important in this case to be certain that the shape of the original curve and the variance of the transformed curve are stable. This principle has been applied by Ferguson[11,12] to the results of mental tests.

The Transformation $X = \log x$

The theoretical justification for using this transformation for most scientific observations is probably better than that for using no transformation at all. The general arguments in favour of it were discussed by Galton[13], who also directed attention to the fact that the normal law predicts negative observations. The existence of men of more than double the average weight implies the existence of other men with negative weight. When logarithms are used this difficulty does not arise.

When measurements are made of the size of a number of small objects of the same shape, it is often possible to measure either their diameters or their volumes. If the distribution of the diameters is normal, then the distribution of the volumes will necessarily be asymmetrical, and vice versa. The normal law cannot be true in both cases. The use of logarithms removes this difficulty[5]. If the logarithms of the diameters are distributed normally with standard deviation λ, the logarithms of the volumes will be distributed normally with standard deviation 3λ.

These theoretical arguments thus lead to the conclusion that this transformation should facilitate the interpretation of results when the variations are large ; when they are small it can at the worst do very little harm, since it has very little effect on the shape of the curve. The extra labour involved in converting the observations to logarithms to base 10 is small, though perhaps sufficient to deter those who deal with small variations. Mathematicians prefer natural logarithms, but experimenters usually prefer ordinary logarithms to base 10, and these give equally good results. The symbol λ is used[8] to denote the standard deviation of the logarithms to base 10.

One logical consequence of the adoption of this method would be that the mean of the logarithms, or the geometric mean of the observations, would be taken as the most likely value, instead of the arithmetic mean. Williams[14,15] obtained direct evidence of the value of this in experiments on the number of insects caught in a light trap. The use of logarithms had the double advantage of making the results more consistent and of preventing the result from depending almost entirely on one aberrant large catch. It is likely that this device would increase the precision of most experiments in which the variation is large.

If the original observations have been grouped on an arithmetic scale, the direct computation of th constants of the transformed distribution may be laborious. These constants can be calculated from the mean ($\bar{x}$) and standard deviation (σ) of the original distribution, but the estimates so obtained are only reasonably efficient when λ is less than 0·14[16]. In this region λ can be estimated within 3 per cent by dividing the coefficient of variation by 231. The general formulæ are

$$\bar{X} = \log_{10} (\bar{x}/(1 + \sigma^2/\bar{x}^2)^{1/2})$$
$$\text{and } \lambda^2 = 0\cdot4343 \log_{10} (1 + \sigma^2/\bar{x}^2).$$

Lognormal Distributions

It is proposed to call the distribution of x 'lognormal' when the distribution of $\log x$ is normal. Lognormal distributions have been discovered in many fields of work. Kapteyn[4] quotes the example of some data by Heymans on the threshold of sensation as measured by the smallest weight which was just perceptible on the skin. Wightman, Trivelli and Sheppard[17] found that the size of the particles of silver in a photographic emulsion were lognormally distributed. The diameters and areas of projection were measured, and it appeared at first that the form of the distribution of both measurements varied in different experiments. When the logarithmic transformation was used, normal curves fitted all the measurements of both diameter and area.

The distribution of sensitivities to drugs among individual animals of the same species, as measured by the dose required to cause some definite effect, has been widely studied. The sensitivity may vary over a tenfold range or more, but in practically every case the logarithm of the sensitivity is normally distributed or nearly so[8,18]. This fact, which is now generally accepted, has proved very convenient in the design of toxicity tests and in the calculation of their errors. The values of λ range from 0·014 to 0·91.

Similar methods have been applied to the action of disinfectants[19] and it has been found that the relation between time and the death-rate of bacteria can be explained, in some cases at least, on the theory that the logarithm of the survival time is normally distributed.

Hemmingsen[20] studied the distribution of the average size of the different species in each of various phylogenetic groups and found that they were distributed approximately lognormally ($\lambda = 0\cdot083$–$0\cdot673$).

Other examples of lognormal distributions have been found in estimates of the numbers of plankton caught in different hauls with a net[21], and in the amounts of electricity used in medium-class homes in the United States[22].

Bacteriologists have to deal with wide ranges of variation, as is illustrated by the data of Brew[23], who calculated coefficients of variation up to 640 per cent in bacterial counts. Such data can only be effectively treated by some such device as that discussed here, and bacteriologists often use a logarithmic scale.

Wechsler[24] collected a large number of data relating to measurements of human beings, and had trouble with their interpretation. The distributions were sometimes normal, but when the variation was large, the curves were skew with the mode less than the mean. He found that it was best to express the range of variation in terms of a ratio, and used for this purpose the ratio of the measurement on the 999th individual out of 1,000 to the measurement on the second individual. When there were less than 1,000 individuals, he was at a loss for a method of extrapolation and took the total range actually covered by the observations. The curves obtained are just the kind which are improved by taking logarithms. A number of the distributions studied by Wechsler are, as a matter of fact, lognormal, or approximately so, and there can be little doubt that their interpretation would have been facilitated by taking logarithms. The values for λ in some of these data have been estimated as follows: height, 0·015, 0·0164, 0·0172, 0·017; blood sugar, 0·029; weight, 0·045, 0·055; blood pressure, 0·049; pulse-rate, 0·061, 0·067. It will be seen that λ for weight is about three times λ for height, as is to be expected theoretically.

Cooper[25] made a number of measurements of the size of drops in emulsions. Some of his distributions were apparently complex, but in the only example for which details are given the diameters (and volumes) are distributed lognormally to a close approximation ($\lambda = 0\cdot17$ for diameter).

Cochran[26] discusses various transformations and comes to the conclusion that the logarithmic one is particularly effective, but that it makes no significant difference when the coefficient of variation is less than 12 per cent. He gives evidence that the standard deviation was proportional to the mean in measurements of the reaction time of human beings in a word test, and concludes that the distribution is likely to be lognormal.

Williams[15,27] has applied the same transformation successfully to data in which the variable was not an actual physical measurement but a count of the number of insects caught in a light trap, or the number of words in a sentence by G. B. Shaw.

Some of the effects of drugs on enzymes, and of oxygen on hæmoglobin, can be explained on the theory that the molecules of a protein in a solution show continuous variations among themselves, and that certain of their properties are lognormally distributed[28].

The Transformation $X = \log (x + x_0)$

If the probit is plotted against $\log x$ and the points diverge from a straight line, it is sometimes possible to find an explanation in such factors as a failure to allow for the mortality occurring when no drug is given, or a failure to count drops too small to be seen. In some cases it may be desirable to find a transformation giving a closer fit to the data than the simple logarithm. One convenient formula is

$$X = \log (x + x_0).$$

This is useful when the curve shows a more or less constant curvature, or with flat curves which diverge most at their lower ends. If the curve is convex upwards with probits as ordinates, x_0 is negative; if it is concave upwards, x_0 is positive. If a good fit is obtained, it suggests that the variations are proportional to the amount that the variable exceeds the value $-x_0$. If full data are available the constants of the curve can be estimated from the mean and the second and third moments of the original distribution[29,30]. Kapteyn[4] gives another method. A rough estimate of x_0 may also be obtained from a graph in the following way. Take three equidistant points on the scale of probits, such as 4, 5 and 6. Estimate from the curve the corresponding values of $\log x$ and thus of x. If these values are x_1, x_2 and x_3, then we wish to determine x_0 so that $(x_2 + x_0)$ shall be the geometric mean of $(x_1 + x_0)$ and $(x_3 + x_0)$, so that $(x_2 + x_0)^2 = (x_1 + x_0)\ (x_3 + x_0)$, or $x_0 = (x_2^2 - x_1\ x_3)/(x_1 + x_3 - 2x_2)$. The success of this correction can be tested by plotting $\log\ (x + x_0)$ against probits. For extrapolation at one end of the curve it may be convenient to choose x_1, x_2 and x_3 near that end.

This transformation has been fitted to observations of the value of house property and of the size of the foreheads of crabs[4], the ages of employees of a commercial firm and the number of petals on a buttercup[29] and the weights of female students[30]. The curves obtained in this way fitted the observations better than formulæ obtained by the methods described by Pearson.

Curves of this type can be fitted to measurements recorded by Nagelschmidt[31] of the diameters of particles of airborne dust in coal mines. In some cases the distributions appear lognormal ($\lambda = 0{\cdot}2$–$0{\cdot}4$), but in others the curves obtained when probits were plotted as ordinates against log diameter were concave upwards. When the transformation $X = \log\ (x + x_0)$ was used, the calculation of χ^2 showed that the fit was good.

Williams[15] used this transformation with $x_0 = 1$ in order to avoid complications in calculating the geometric mean when $x = 0$. This only affects the shape of the curve for small values of x.

Conclusion

If it were the normal custom, when scientific observations show uncontrolled variations large compared with the observations themselves, to convert them to logarithms before estimating their mean or variance, the usual result would be an increase in the accuracy and scope of the conclusions drawn from them.

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NEW VIEWS OF THE ORIGIN OF THE SOLAR SYSTEM

By Prof. W. H. McCREA

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THE field is still open for the formulation *de novo* of theories of the origin of the solar system. No observational test has ever been discovered which would impose a definitive restriction upon the basic possibilities, as, for example, to show whether or not we must look to some catastrophic event to produce the necessary initial conditions.

Interest in the problem has recently been revived by attempts to approach it afresh along three totally independent lines. Von Weizsäcker[1] proposes what amounts to a re-instatement of the nebular hypothesis, with the incorporation of several novel features; Alfvén[2] makes the radical suggestion that it was the magnetic field of the sun which governed the manner in which it acquired the material of the planets from interstellar space; Hoyle invokes a nova outburst as a catastrophic origin of this material. None of these theories can as yet claim completely to demonstrate that a planetary system must inevitably have resulted from its postulated initial conditions. But they all offer apparent explanations of some or other of the general characteristics of the actual planetary system. In spite of their diverse approaches, it is not impossible that further progress may be made by combining ideas drawn from more than one of them*.

At the same time, thanks to suggestions by Jeffreys and others, the idea is gaining ground that the basic agency in the formation of the solid substance of planets may be no more than the most common form of condensation from a vapour to a solid. This may prove to be a simplifying factor in the whole problem.

Weizsäcker's Theory

Weizsäcker's theory belongs to the class of those which seek the origin of a planetary system in a rotating nebulous envelope around an already existing sun. His fundamental hypothesis is that the chemical composition of the envelope was initially the same as that of the sun itself. Since the chemical composition of the present planets is very different (comprising a bigger proportion of the heavier elements) they can then represent only a fraction of the original mass of the envelope. Weizsäcker takes this fraction to be as low as one per cent. For he accepts a recent estimate by Biermann[3] for the composition of the sun, which gives it a much higher content of the lighter elements than is currently assumed. In this manner he proposes to overcome the difficulty, encountered by older theories of this class, that the initial density of the envelope would have been too small to lead by the ordinarily recognized gravitational processes to condensation into planetary bodies. At the same time, through the dissipation of the surplus 99 per cen composed of light elements, he proposes to accoun for the disappearance of an embarrassing amount o angular momentum.

Weizsäcker envisages several stages in the evolution of his system, each of which he investigates in detail. But it has to be said that the way in which i is conceived to pass from one stage to the next involves a number of obscurities.

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* The meeting of the Royal Astronomical Society on July 13, 194 was devoted to a discussion of these theories, which were outline respectively by the present writer, Dr. A. Hunter, and Mr. F. Hoyl Subsequent speakers were Prof. H. H. Plaskett, Prof. S. Chapma Dr. H. Jeffreys, Dr. G. P. Kuiper and others. This article is a dige of what was said, with some slight additional commentary; it do not treat other recently proposed theories not included in the di cussion, such as that of J. B. S. Haldane, *Nature*, 155, 133 (1945).

The envelope is considered to have been acquired in some relatively dense part of the general interstellar cloud. Since the latter was presumably in a state of turbulence, the first picture of the envelope is of an aggregate of portions of gas and dust particles moving n more or less independent orbits in the sun's gravitational field, the planes of the orbits being orientated in a haphazard fashion. Assuming a non-zero resultant angular momentum, the first effect of viscous interactions between the parts of the system is to bring them into nearly circular orbits in or near the plane through the sun normal to the axis of this momentum. This produces a flattening of the envelope; Weizsäcker estimates its resulting second stage to be approximately a disk of diameter about equal to that of the present solar system and thickness rather less than one-hundredth of this, the emperature of the material at any point being about the same as a planet there would possess at the present time.

By virtue of the orbital motions, the angular velocity of the material about the sun decreases outwards. The next effect of viscosity is to tend to equalize the angular velocity throughout. Now there is a familiar argument which appears to show that this results in a dissipation of the material, and such, fundamentally, s the process by which Weizsäcker disposes of his excess material. The argument, however, is one which Jeffreys has shown to be unsound, the actual effect of viscosity in such a system being mainly to cause the material gradually to ooze into the central body. Nevertheless, this in itself does not necessarily vitiate Weizsäcker's further inference that viscosity must produce turbulent convection currents in the material.

Weizsäcker argues that if the viscous forces are ufficiently small we should expect these currents to build up into some regular pattern. The endeavour to discover such a pattern is the central part of his whole work. He eventually proposes one consisting of a series of rings of large-scale 'vortices' moving with etrograde circulation between concentric circles long which there are trains of small turbulent eddies possessing direct rotation. In the 'vortices' themelves, turbulence is almost negligible and the eddies erve somewhat as 'ball-bearings' between them. A quantum condition' that an integral number of vortices should just fill each ring, coupled with ertain conditions concerning the stability of individual vortices, requires the radius of the *n*th circle of the set to be proportional to 2^n.

Finally, Weizsäcker believes that the eddies must come together, and that this behaviour leads ultimately to the formation of planets by a mechanism of ccretion. This way of locating the formation of anets gives satisfactory agreement with Bode's w concerning their distances from the sun. The act that it does so is claimed by Weizsäcker as evidence for the occurrence of the whole process. He then ds scope in the theory for the production of satellites.

The pattern of 'vortices' may in itself possess all e properties that Weizsäcker ascribes to it. But it founded upon a set of gravitational orbits which nstitutes an extraordinarily special selection from among those of any random aggregate of such orbits. fact the selected set possesses certain characteriss the reverse of the statistical ones of a random set. it is exceedingly hard to conceive how it could turally have arisen from any earlier state of the system. It is therefore scarcely to be expected that the theory will survive in anything like its present form. Its value will probably lie rather in stimulating a re-examination of many aspects of non-catastrophic processes which could have had some part in the formation of planets.

Alfvén's Theory

This theory, like the preceding one, supposes that the raw material of the planetary system was collected by the sun from interstellar space, but it makes everything depend upon the mechanism by which this was achieved. Alfvén's suggestion is briefly this: The sun was rotating and possessed a dipole magnetic moment; neutral atoms fell towards it under gravitational attraction until their motion became thermal owing to collisions and produced ionization; electromagnetic forces on the ions in the magnetic field overwhelmed gravity and prevented their falling further; the trajectories in the magnetic field led to an accumulation of ions in a thin layer near the sun's equatorial plane; there they once again became neutral and so acquired gravitational orbits; the planets then emerged as a result of a mode of coalescence described by Lindblad[4]. More precisely, this process is thought to have produced the major planets, while a similar one applied to dust-particles instead of gaseous atoms gives the others. The process necessarily involves a transfer of angular momentum from the sun to the captured material.

The fundamental difficulty of this approach is the question as to whether the sun can in fact possess the requisite unshielded magnetic field. A possible view is that its general field is inappreciable outside its own atmosphere, though it has been suggested that there may be slight evidence to the contrary in some observed features of comets' tails. Further, many questions concerning the production of the ions and concerning their mean free paths demand closer investigation than Alfvén has yet given.

So the situation is that, while electromagnetic effects would be of over-riding importance in the early stages under the conditions imagined by Alfvén, the realization of those conditions is still far from being an established fact. But his work does at least demand that, in the sort of re-examination contemplated at the end of the preceding section, the possibility of electromagnetic effects must be thoroughly investigated.

There are also points regarding the later stages which are not elucidated by Alfvén's work. For example, though it yields a density distribution which would give fairly correct relative masses of the planets were the material divided up at appropriate distances from the sun, it provides no clue as to why this particular division should in fact occur.

Hoyle's Theory

Hoyle believes that the difficulty of accounting for the mere quantity of material in the planets, if it is supposed to have been gathered from interstellar space, is more serious than the preceding theories allow. He therefore reverts to the hypothesis of a stellar, rather than interstellar, source of material. But instead of the more customary assumption that it was pulled out by a collision, he suggests that it was pushed out during a nova outburst. He cites the case of the Crab Nebula as showing that such a process can certainly involve a plentiful supply of potential raw material: since it started as a supernova in A.D. 1054, an estimated quantity amounting to about fifteen times the mass of the sun has been ejected. In such a case the material comes away with very high velocities. But Hoyle asks what would have happened had the original star been a binary.

Suppose the sun had at one time possessed a companion at about the distance of Jupiter, and suppose this companion became a nova. The ejected matter might not then come off with complete isotropy, so that the nucleus of the nova might have been knocked out of the system. When the outburst was dying down, some of the ejected matter may have had insufficient energy to escape from the gravitational field of the sun. This is Hoyle's suggested source of material for the formation of planets; the captured material need represent only a modest fraction, perhaps of the order of 10^{-4}, of the total ejected matter. The resultant angular momentum is regarded as traceable to the original orbital motion of the binary. However, the idea is so far only in tentative form; its author will no doubt shortly provide a fuller discussion.

Condensation Processes

Hitherto, gravitation has usually been thought of as the fundamental agency responsible for the condensation of nebulous matter into planetary bodies, either by causing a cloud of such matter to collapse upon itself under its own gravitation, or else by aiding accretion by causing particles of a cloud to fall towards an incipient planet passing through it. Jeffreys[5] has, however, recently posed the crucial question as to whether gravitation is the only important agency in producing condensation. The commonest process of condensation with which we are familiar is that represented by a raindrop. Is it possible that this process plays a part in the formation of a planet? The actual form of the process would be more like that which occurs in the production of a snowflake, condensation being directly into the solid state. The only criterion as to whether it will take place is that the partial pressure in the surrounding gas should exceed the vapour pressure of the solid. The necessary figures for the vapour pressures of planetary matter in the solid state are difficult to come by; but Parson[6] has given estimates according to which the criterion is likely to be satisfied at the kind of temperature to be encountered at, say, the distance of Jupiter even for existing pressures there.

The merit of such condensation as the key to the production of planetary material is that it can proceed in much less specialized conditions than the elaborations of the various theories are designed to provide. It is, in fact, fundamentally equivalent to an earlier suggestion by Lindblad[4].

Some indication of the validity of these ideas may be found in the fact that there are in the solar system small bodies, the density of which is less than that of any known solid. Jeffreys's suggestion is that such a body may be a loose agglomeration of crystals which have grown by this process of condensation—that the body possesses, in fact, the structure of a large snowball.

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[2] Alfvén, H., *Stockholms Obs. Ann.*, 14, No. 2 (1942); No. 5 (1943); *Nature*, 152, 721 (1943). An account of the theory and of the difficulties in previous theories which it is designed to overcome is given by A. Hunter, *Nature*, 156, 378 (1945).

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REACTIONS AT INTERFACES AND THEIR SIGNIFICANCE IN BIOLOGY

By Dr. J. F. DANIELLI
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IN his Liversidge Lecture before the Chemica Society, on "Reactions in Monolayers", Prof E. K. Rideal made the most comprehensive survey yet available of studies of chemical reactions i monolayers. This is a field of chemistry which ha recently become of exceptional interest to th biologist, so much so that the cell physiologist canno afford to be ignorant of the progress which has bee achieved in the last fifteen years; this is all th more remarkable in that thirty years ago this aspec of chemistry, practically speaking, did not exist.

It has, of course, for long been realized tha reactions at interfaces present peculiar features, an that some of these may be of great importance i biology. F. G. Donnan laid emphasis on the import ance of surfaces in biology when giving the fir Liversidge Lecture. But before biologists could begi to consider these theoretical possibilities in relatio to their special field it was requisite: first, that tech niques should be devised capable of dealing with th surface properties of molecules of types of biologica interest; and secondly, that an exploration shoul be made of the types of reaction and behaviou particularly characteristic of molecules at interface The first of these steps was to a large degree accom plished by the early nineteen thirties, but the secon phase was barely commenced. N. K. Adam ha made some studies of hydrolysis of lactones in mon layers, and of the oxidation of cholesterol monolayer which were highly suggestive. To-day a substanti part of the field has received a preliminary survey largely embodied in reports from Prof. Rideal's ow laboratory, and, though only parts of the field ha been touched, it is already apparent that it will yiel results of the greatest value to biologists.

From a theoretical point of view, the importan of this field is sufficiently emphasized if we consid some of the reactions involving the common maj components of living tissues—fats, proteins, nucle tides and carbohydrates. The great majority of t natural fats are so insoluble in water that the reactivity as individual molecules in aqueous soluti can be neglected. The final steps in their synthes and the initial steps in their utilization, must occ either in the interior of a lipoid phase or at a lipoi water interface. The enzymes catalysing the reactions are insoluble in lipoids, so that the reacti site is limited to interfacial regions. The same is tr of the steroids. The proteins are thought by so to be synthesized as polypeptide chains adsorbed oil-water interfaces, and to acquire specific chara teristics as globular proteins by processes occurri on desorption. Whether this be so or not, it is cert that a protein molecule, in the later stages of synthesis, itself constitutes a moderately well-defin interface, in the vicinity of which any further sy thetic or degradative reactions must occur. Final the enzymes catalysing the reactions affecting fa steroids, proteins, nucleotides and carbohydrates themselves such large molecules that the reacti they catalyse are in fact occurring at the surface the enzymes, that is, at an enzyme-water interfa and in no sense in a homogeneous solution. In bri it is fair to say that the present state of knowle indicates that the vast majority of the chemical reactions occurring *in vivo* are reactions occurring at interfaces, and moreover at interfaces resembling in type those which can be explored by present-day surface techniques.

That chemical equilibria at interfaces would be different from those in homogeneous solution was suggested by J. J. Thomson (1888), in his work "Application of Dynamics to Physics and Chemistry". Much attention has from time to time been devoted to the study of this principle, and H. Freundlich (1930), when giving the second Liversidge Lecture, brought together many striking examples of this phenomenon. We now know that interfacial regions differ from the homogeneous phases with which they are in contact in many particulars: the *p*H, ionic strength, oxidation-reduction potential and the ratio of univalent to polyvalent ions at an interface may all differ substantially from their values in the surrounding bulk phases. In addition to these differences, molecules diffusing into the interface will often be subject to special forces produced by the orientaion of molecules at the interface, as a result of which unusual concentrations and juxtapositions of paricular chemical groupings may arise, and to a sharp electrical potential gradient in the interfacial region produced by the oriented polar groups of the interfacial molecules. Some of the effects of these peculiarities of interfaces may be demonstrated by very simple experiments. Deutsch (1929) showed hat if an aqueous solution of a *p*H indicator is shaken with a little liquid hydrocarbon, a marked colour change will occur if the *p*H of the aqueous olution is in the region in which the indicator is sensitive. The colour change produced by shaking is aused by adsorption of indicator on to the surface of the emulsified hydrocarbon, and is quite reversible, he original colour returning as the emulsion breaks. The change in colour on adsorption is produced by a shift in chemical equilibrium subsequent to adsorpion. Later studies have shown that the shift is mainly caused by the fact that the *p*H in an interacial region differs from that in the surrounding bulk phases. The colour shift shown by this experiment of Deutsch is in some ways allied to what is commonly known as the 'protein error' with *p*H indicators. When *p*H indicators are added to aqueous solutions of proteins, the colour produced may indicate a *p*H differing by more than a *p*H unit from the true value, given by a glass electrode. This 'error' has been shown to be produced, in part at least, by the fact that the *p*H at the surface of a protein molecule is substantially different from that of the bulk aqueous phase in which the protein is dissolved. When the indicator is adsorbed, it of course tends to react to the interfacial *p*H, not to the bulk *p*H.

A similar displacement of equilibrium is observed a monolayer of palmitic acid is spread upon a solution of sodium and calcium acetate. If the sodium : calcium ratio in the acetate solution is 00 : 1, we might perhaps expect to find a similar atio in the monolayer. But when the monolayer is wept off the solution and analysed, it is found that here is rather more calcium than sodium in the monolayer! This phenomenon lies behind the efficiency of calcium as an antagonist of the detergent ction of soaps, and is likely to be concerned in etermining the so-called 'physiological ratio' of odium to calcium. For normal physiological ehaviour of a tissue it is usually necessary that the fluid bathing it should have a sodium : calcium ratio of the order of 100 : 1. That one calcium ion should be competent to balance the action of a hundred sodium ions is inconceivable; but if, as we now believe, the site of action of the ions is a surface, and at this surface rough equality of concentration and balance of action of sodium and calcium is produced by a bulk ratio of 100 : 1, then we have a reasonable explanation of the importance of the physiological ratio of this order.

Experiments such as those just mentioned are not those with which Prof. Rideal was particularly concerned, but formed part of the background of less specific factors against which the review of more specific factors given in his lecture must be viewed. By using the special techniques of surface chemistry, he and his colleagues have been able to study many details of behaviour of the molecules which are more permanently fixed at an interface. For example, it has been shown that the velocity with which a molecule in a monolayer will react with a constituent of the bulk solution is a function of the closeness of packing of the molecules; the closer the molecules are together, the more slowly they react with the bulk phase component. This is true of the hydrolysis of lactones and esters by hydroxyl ions, and of the oxidation of unsaturated fatty acids by acid permanganate solution. Compression of a monolayer of such substances affects the rate of reaction by changing both the energy of activation and the steric factor, as may be shown by the case of the hydrolysis of trilaurin by hydroxyl ions: when the surface pressure, that is, the force compressing the monolayer in the two dimensions of the surface, is raised from 5·4 to 16·2 dynes/cm., the activation energy is raised from 10,100 to 15,100 calories, while the steric factor increases from $1 \cdot 1 \times 10^{-6}$ to $4 \cdot 1 \times 10^{-2}$. The velocity of hydrolysis of esters in monolayers is also affected by the orientation of the different parts of a molecule with respect to one another. Cetyl palmitate takes up one type of configuration giving a velocity constant of 0·18 min.$^{-1}$ under a given set of conditions, whereas ethyl palmitate, taking up a quite different configuration at an interface, has a velocity constant under the same conditions of 0·005 min.$^{-1}$. Prof. Rideal points out that there is some degree of parallelism between the phenomena observed when esters in monolayers are hydrolysed by hydroxyl ions, and those observed when the enzyme lipase is the catalytic agent. It would be of great interest to see such studies extended, though a pre-condition for analysis of the enzyme studies may perhaps be the isolation of pure lipase, which has not yet been achieved. But even the present state of investigation is of interest and assistance to the biologist in the formulation of working hypotheses concerning the control of enzymic reactions. One of the central problems of the cell physiologist is to discover the mechanisms whereby the rates of enzymic reactions are adjusted to suit the needs of the organism. It is common for enzyme and substrate to exist in the same cell, apparently in close proximity, and yet no net reaction will proceed until a particular phase of physiological activity is embarked upon. The influence of surface pressure on reaction velocity indicates one means whereby a reaction may be held in abeyance until required.

Another phenomenon of great interest to biologists is the formation of molecular complexes between molecular types such as fats, steroids, phospho-lipins, proteins and lytic molecules. Monolayer techniques form an unusually elegant means of studying these complexes. When a second substance is injected into the aqueous solution underlying a monolayer of a pure substance, a large increase in surface pressure is found if complex formation occurs accompanied by penetration of the second molecular species into the monolayer. If the reaction is between polar groups only of the two molecular species, there may be no change of surface pressure, but there will be a change in the electrical potential across the film. If there is no complex formation of any type, no change in either surface pressure or potential occurs. Complex formation of the type revealed by these surface techniques has been shown to be of importance in the mechanism of red cell lysis, and in the permeation of some membranes by such substances as phenols. For example, the penetration of hexyl resorcinol into *Ascaris lumbricoides*, according to Trim and Alexander, may be accelerated by a factor of about fourfold by adding low concentrations of detergents, with which the resorcinol forms complexes. The mechanism of this acceleration is not yet understood, and may well repay detailed study.

Interesting complexes are formed between some carotenoids and certain proteins. Astaxanthin exists in the eggs and integument of lobsters, crabs, etc., as a blue-green pigment. The carotenoid is readily oxidized to astacene in the dead animals. When the association between carotenoid and specific protein breaks down, a colour-change ensues. The association may be destroyed by boiling, which denatures the specific protein, or by addition of sodium soaps. In the latter case, the change is reversible, restoration of the original complex being achieved by addition of calcium (Peters and Wakelin). Visual purple also appears to be a complex of this type, namely, protein-carotenoid. One theory of the action of light upon visual purple is that it oxidizes a termina CHOH group of a polyene chain to the corresponding aldehyde. Monolayer studies show that on conversion of a CHOH group to a CO group, a large change of surface potential occurs. It is therefore possible that, if the carotenoid of visual purple also forms part of the lipoid layer of the cell membrane the photo-oxidation will produce a change in surface potential sufficient to cause electrical excitation o the cell. These relationships are at present all highly speculative, but it is in harmony with recent developments in cell physiology to adopt the working hypothesis that the stimulation of retinal cells by light is produced by a surface photo-oxidation of the visual pigment incorporated in the cell membrane and that the change in surface potential produced by this reaction temporarily discharges the resting potential of the cell, causing an electrical response.

These reflexions on the topics of Prof. Rideal's lecture show that a pathway for investigation of many biological problems has already been secured by the study of reactions at interfaces. So numerous are these possibilities that the rate of investigation o these fields is likely in the immediate future to be determined almost entirely by the number of investigators available; all such investigators will find a source of inspiration in Prof. Rideal's lecture.

OBITUARIES

Prof. Ernest Shearer

A NATIVE of the island of Stromness in Orkney, Ernest Shearer was brought up to farming; but he could also sail a boat and follow the maritime pursuits of his Viking ancestry. A 'lad of parts', he was thoroughly schooled in mathematics and classics and went on to the University of Edinburgh where, between 1897 and 1904, he studied and graduated M.A. with honours in economics and B.Sc. in agriculture. His first appointment was to the Indian Agricultural Service, where in five years he reached the grade of assistant inspector-general. In 1911 he was appointed under the Egyptian Government as principal of the Giza Higher College of Agriculture and in 1919 he was made chief technical officer in the Egyptian Ministry of Agriculture.

In 1924 Shearer accepted the post of principal in the Edinburgh and East of Scotland Agricultural College; two years later he was made professor of agriculture in the University, thus becoming the first head of the Edinburgh School of Agriculture. During his tenure of office the proper utilization of land and the teaching of young farmers became more and more of national importance, and he rose to eminence as an authority on agricultural education. He reached this position by reason of his training and experience, but also because of inclination, for he had a great interest in, and sympathy for, young people. When he retired from his academic posts in the autumn of 1944 he became secretary to the Mid and East Lothian Agricultural Executive Committees, and thus continued to serve the farming community until the time of his death.

Shearer was a large and genial man, entirely fre from affectation, with a strong sense of humour and great personal charm. Completely at ease in an situation, he would pass an hour as happily with his gardener as with his fellows on the Senate. He handled a brilliant pen and possessed great strengt of character and determination. Not only was h thus well qualified for leadership but he could als be relied on to fight for any right cause and to stan like a bulwark in the interests of his people.

His hobby was the propagation of fine fruits an beautiful flowers. He had planned to retire to h beloved Orkney and to devote himself to the production of plants which would bring both ameniti and profit to the island farmers. His untimely deat is, therefore, as much a loss to his native land as is a grievous blow to his friends and colleagues.

J. A. MORE.

Mr. L. E. Adams

LIONEL ERNEST ADAMS, who was well known to a earlier generation as an active and enthusiast observer of the natural history of the British Isle died at Ryde, Isle of Wight, on September 20, at t age of ninety.

Adams was the nephew of Henry and Arth Adams, famous in their day for their researches the molluscs, and joint authors of "The Genera Recent Mollusca". Circumstances did not allow hi to follow his uncles' wider sweep, and he had confine himself to the British land and freshwat species, on which he became an authority of reput

In 1884 he published "The Collectors' Manual of British Land and Freshwater Shells" with coloured plates drawn by his brother Gerald, but the figures of *Pupa* and *Vertigo* (Pl. vii, Figs. 10–22) prove that the author himself was no mean artist; a second edition appeared in 1896. Apart from this one book, Adams published many notes and papers in various natural history journals, especially in the *Journal of Conchology*. Most of these dealt with the habits of the animals, and were precursors of the ecological studies so fashionable to-day.

The native mammals of Britain attracted him strongly, and on them he spent much of his energy. The most widely known of these researches is that on the 'fortress' of the mole. After digging out no fewer than three hundred of these structures, Adams was able to show that not one of them was like the familiar figure derived from Blasius and Geoffroy St. Hilaire, which had been copied by one or another writer of popular works for more than a hundred years.

Even this did not exhaust Adams's activities. There was scarcely a group of invertebrates from earthworms to woodlice which he did not collect at some time or other, either on his own behalf or because he knew that someone needed the material for study. In the field he was a lively companion, a noted teller of stories; as a correspondent he was prompt and accurate, ready to pass on all the information at his disposal. A. T. HOPWOOD.

WE regret to announce the following deaths:

Prof. George R. Gage, professor of botany in Vanderbilt University, Nashville, Tennessee, on August 18, aged fifty-five.

Mr. C. F. Dendy Marshall, a founder member and past-president of the Newcomen Society and an authority on the early history of railways, on June 14, aged seventy-two.

NEWS and VIEWS

Biochemistry at University College, London: Prof. F. G. Young

PROF. F. G. YOUNG is relinquishing his chair at St. Thomas's Hospital Medical School to succeed Sir Jack Drummond as professor of biochemistry at University College, London. In so doing, Prof. Young will be renewing a long association with University College, of which he was an undergraduate in the honours school of chemistry; for, in addition to receiving his early training there, he was successively (1929–32) Bayliss-Starling Scholar in biochemistry, Sharpey Scholar and Shafer Prizeman in physiology. After holding Beit Memorial fellowships for medical research, Prof. Young then gained further experience by serving as honorary research assistant in the Department of Physiology, Aberdeen, and research associate, Department of Physiology, Toronto, returning to University College in 1934 as honorary assistant in the Department of Biochemistry. Two years later he joined the scientific staff of the Medical Research Council, on which he stayed until his appointment to the chair at St. Thomas's Hospital Medical School in 1942.

Prof. Young has already established an international reputation for himself by his research work. Commencing with the intermediary metabolism of carbohydrates, he was led naturally to the study of the diabetogenic action of extracts of the anterior pituitary and later to other activities of this gland. With Folley he published an important contribution upon the lactogenic hormone which led to further studies with Folley and others on the galactopoietic action of pituitary extracts. It is, however, in the sphere of carbohydrate metabolism that Prof. Young's chief interest has resided and in which his most numerous contributions have been made. In addition to his great activity as a research worker, Prof. Young has also given generously of his time to the Biochemical Society, which he served as joint secretary during 1938–42. In this year he was elected chairman of the editorial board of the *Biochemical Journal*, and the high standard maintained by that journal is an eloquent tribute to the success of his vigorous leadership. Prof. Young will carry the good wishes of all his colleagues with him to University College.

Prof. John Yudkin

DR. JOHN YUDKIN, whose appointment to the chair of physiology at King's College of Household and Social Science (University of London) has recently been announced, takes with him from Cambridge a high reputation as an experienced and successful teacher. Since 1934 he has been supervisor in biochemistry and physiology at Christ's and Emmanuel Colleges, and since 1940 director of medical studies at Christ's. He is also distinguished as an investigator with wide interests in several fields of biochemistry and nutrition. Possessing a particular regard for the social implications of nutritional knowledge and its application in public health, he has shown much organizing ability in the planning of various nutritional and dietary surveys. Dr. Yudkin entered Christ's College with an open scholarship in 1929 and graduated in 1931, after taking biochemistry in Part 2 of the Natural Sciences Tripos. He was awarded the Benn Levy Research Studentship in 1933, and for some years was engaged in research at the School of Biochemistry and the Department of Colloid Science, Cambridge, on problems relating to bacterial enzymes, with special reference to the mechanism of adaptation and variation. In 1936 he interrupted his research work temporarily in order to complete his medical qualification; he received the Letheby Prize in pathology at the London Hospital.

Since 1936 Dr. Yudkin has specialized in nutritional investigations, and has been attached to the Dunn Nutritional Laboratory, Cambridge, where he has held successively a Grocers' Scholarship and a Halley Stewart Fellowship. He is author, or part author, of some twenty publications on the subject: the topics in which he has been specially interested including, *inter alia*, vitamin B_1 metabolism; dark adaptation and slit-lamp microscopy; dietary and nutritional surveys on school children and factory workers; and feeding tests with vitamins and other supplements. He joined the R.A.M.C. in 1943, being first attached to the R.A.M.C. College in London, and later as pathologist to the West African Forces, Sierra Leone, and has published a number of papers from both these centres.

Naval Research and Development

Dr. C. F. Goodeve, the first holder of the post of deputy controller for research and development in the Admiralty, has left the department to take up the directorship of the British Iron and Steel Research Association. The post of assistant controller for research and development was instituted in 1942 and the status of the post has since been raised to that of deputy controller. The holder not only helps the controller of the Navy in supervising the application of science, technology and design engineering in the large range of departments which work under his superintendence, but is also adviser to the Board on research and development generally. Before Dr. Goodeve was appointed to this post he had been for some time previously associated with the Admiralty as an R.N.V.R. officer.

The new deputy controller for research and development is Mr. A. P. Rowe, who has during the War been head of the largest radar research establishment in Britain, the telecommunications research establishment at Malvern. This establishment, under the Minister of Aircraft Production, has been responsible for the research and design of the radar equipment both of the R.A.F. and the Fleet Air Arm. Mr. Rowe's connexions with defence research work go back to 1922, when he first joined the scientific staff of the Air Ministry.

Terrestrial Magnetism and Atmospheric Electricity

The present year, 1945, will mark the completion of the fiftieth year of the quarterly publication, *Terrestrial Magnetism and Atmospheric Electricity*, the foundation of which by L. A. Bauer in 1896 was a step of far-reaching importance for the progress of the sciences named in its title. It provides a most valuable focus and forum for them, and for border subjects related to them, such as sunspot and ionospheric studies. Though the editorial and financial responsibility for the periodical has always been American, in the hands of its two successive editors, L. A. Bauer (1896–1932) and J. A. Fleming (1928 to date), the periodical is international in the sense that foreign associates have been and are linked with the responsible editors, and can advise or make suggestions either when requested or on their own initiative; and also that suitable contributions from all countries have been welcomed and have provided a considerable share of the matter printed. Moreover, though most of the papers are printed in English, and always have been, papers are invited also in French, German and Italian. The pages of the fifty volumes well mirror the great progress that has been made in these branches of geophysics during the half-century, and the printing and production have been maintained at a high standard from the outset, and throughout the war years. The subscription-rate, 3.50 dollars per year, is less than double that of 1896, and is remarkably low for a periodical of its size and excellence. The best wishes of the Editors and of many of the readers of *Nature* will be with the direction of *Terrestrial Magnetism* as it begins its second half-century next year.

Science and Development in Australia

The John Murtagh Macrossan Memorial Lectures delivered to the University of Queensland by Sir David Rivett on June 13 and 15, 1944, on "The Application of Science to Industry in Australia", have now been published (Brisbane: University of Queensland. Pp. 48). Sir David, while emphasizing the importance of the international exchange of ideas and thought and of traffic in the products of the experimental laboratory and of the original mind, points out that some decrease in the international to-and-fro movements of products of soil and factory, and in particular a diminished demand overseas for Australian primary products, may be expected, and may even be desirable, to eliminate unnecessary transport. Distribution, he suggested, has become once more a main factor in Australian economy; if we look after consumption, both in quality and in quantity, production will look after itself. That involves basing industrial life on the best human knowledge that is available or ascertainable; and if industrial activity in Australia is to be much more diversified, some general ideas as to the main lines of development and the place of scientific effort in that development are essential. We must think in advance so far as possible in a democracy; but we should do so with the clear understanding that the divergent phenomena of which all plans concerned with human relations have to take account make most plans nothing more than intelligent guesses as to the best justifiable and possible courses. As such they should, like any other hypothesis of the scientific worker, be discarded or amended when the facts prove such treatment to be necessary.

With regard to primary resources, Sir David Rivett believes that Australia should find more consumers within her own borders, these consumers making other products required in return. The building up of secondary industries is imperative, and Sir David referred particularly to shipbuilding and the aircraft industry, light metals and alloy steels for these and other transport purposes, including the motor-car industry, the manufacture of goods for the electrical industry, building materials, household accessories, organic chemicals from alcohol, coal and carbide, engineering, the prepared food industry and mineral industries from the raw material to the finished product. Not more than 200,000 out of every million people would be required to supply that million with foodstuffs and clothing by Australian standards, and the remaining 800,000 should be absorbed in such secondary industries. Such development will only be possible if the universities of Australia are adequately developed and take their full place in fundamental research. National laboratories will be required for such work; but science must not be regarded as just the handmaid of industry. Industry should attend to its own scientific housekeeping, and the national laboratories and the universities should be given the utmost freedom to prosecute fundamental research. Urging the importance of education as a factor in industrial development, he referred finally to the problem of the impact of society upon science: the outstanding problem, he believes, is the handling of our present and coming powers so that their enormous possibilities for the good of humanity will be realized and applied to the total exclusion of any deliberate pursuit of evil aims.

Scientific Rehabilitation in Europe

Prof. G. I. Finch, professor of applied physical chemistry in the Imperial College of Science and Technology, is visiting Belgium and Holland to convey the greetings of the Royal Society on behalf of the men of science of Great Britain to their colleagues in those countries. The purpose of his visit is to renew and re-establish scientific contacts and to see what help can be given by British science towards the rehabilitation of science and scientific education in these two countries. In Belgium, Prof. Finch will be the guest of the Académie Royale des Sciences, des Lettres et des Beaux-Arts in Brussels, and in Holland he will be the guest of the Koninklijke Akademie van Wetenschappen.

Prof. I. M. Heilbron, professor of organic chemistry in the Imperial College of Science and Technology, and Dr. L. H. Lampitt, who are chairman and secretary of the British National Committee for Chemistry, have left on a visit to Paris to re-establish contact with French men of science. They hope to discuss informally the revival of international collaboration in science.

Nova Tamm

A TELEGRAM from Copenhagen announces the discovery by Dr. Tamm of a nova in the constellation of Aquila. It is thought that the nova will be named after its discoverer. On August 28, the date of its discovery, its visual magnitude was about 7 and its photographic magnitude 8·5. It was stated that there was a strong continuous spectrum with emission lines.

Dr. W. H. Steavenson observed the nova and gave more precise co-ordinates than those originally supplied. Its position, according to Dr. Steavenson, is R.A. 19h. 16m. 31s., Dec. + 0° 31·6′; equinox 1945·0; comparison stars + 0·4173° and + 0·4178°. Dr. Steavenson observed the nova on August 31 and found that it was pure white to the eye. Numerous bright lines in the spectrum, especially in the green and blue regions, were seen. He estimated the magnitude (visual) as 7·9. A later communication from Copenhagen states that the photographic magnitude originally given was very inaccurate. On August 30 it was 7·6. The position of the nova is now given as R.A. 19h. 16m. 30·64s., Dec. + 0° 31′ 45·4″.

Announcements

THE Lord President of the Council has appointed Prof. H. Munro Fox, professor of zoology in the University of London (Bedford College), Prof. I. M. Heilbron, professor of organic chemistry in the Imperial College of Science and Technology, London, and Dr. C. C. Paterson, director of the Research Laboratories of the General Electric Co., Ltd., to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research from October 1. Prof. A. V. Hill, Sir Felix Pole and Sir Robert Robinson retired from the Council on completion of their terms of office on September 30.

THE Council of the Institute of Welding has awarded the Sir William J. Larke Medal for 1945, together with a first prize of £50, to Mr. W. K. B. Marshall of the Aluminium Plant and Vessel Co., Ltd., for a paper entitled "The Fabrication of Aircraft Fuel Tanks in Aluminium Alloy containing 5% Magnesium". The second prize has been awarded to Mr. J. Corston MacKain, of Redpath Brown and Co., Ltd. A third prize was awarded to the late Mr. H. W. Clark, formerly assistant engineer (bridges and structures) to the London Passenger Transport Board; Mr. Clark was the winner of the Medal in 1944. The fourth prize goes to Mr. R. W. Arden, of Peterborough.

THE Theobald Smith Gold Medal of the American Academy of Tropical Medicine has been awarded to Dr. C. M. Wenyon, formerly director of the Wellcome Foundation Research Laboratories. The Medal will be presented to Dr. Wenyon in London through the United States Embassy.

THE Veterinary Educational Trust has made the following awards: *Boots Undergraduate Scholarships* (£150 per annum): M. H. Cross (University of Liverpool), G. Shattock (Royal Veterinary College), G. Sumner Smith (University of Liverpool), H. S. Taylor (University of Liverpool). *Halford Undergraduate Scholarships* (£100 per annum): Gordon Cox (Royal Veterinary College), D. C. Croft (University of Liverpool). All the scholarships are awarded for the full course of study for the diploma of M.R.C.V.S. These awards bring the total of undergraduate scholarships so far awarded by the Trust up to eighteen. In addition, eight research fellowships of an annual value of £450–£800 have been awarded for the investigation of veterinary problems of urgent importance.

THE following appointments have been made in the University of Sheffield: Mr. L. Mirsky to be assistant lecturer in mathematics; Dr. J. A. Pope to be lecturer in mechanical engineering.

The following resignations have taken place: Dr. E. T. Goodwin, lecturer in mathematics; Mr. J. H. Read, lecturer in chemistry; Dr. J. Shirley, lecturer in geology; Dr. W. Davies, temporary assistant lecturer in geology; Colonel R. G. Bellamy, lecturer in mechanical engineering; Miss M. C. Simpson, assistant bacteriologist.

THE Genetical Society is holding special meetings during October 31–November 2, at which several European geneticists will describe work and thought in that field in their own countries, and British geneticists will speak on progress in Britain. The meetings will be held at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1.

THE Society of Czechoslovakian Mathematicians and Physicists is arranging a conference on the use of X-ray methods in the metal industry to be held in Prague during November 21–25. Some twenty-five Czech specialists and also invited guests from foreign countries will deliver lectures on the application of X-rays to the study of foundry sands, electrolytically deposited metals, deformation in polycrystalline materials, light alloys, fatigue in metals, welding, etc.; and on the use of gamma rays on material testing. The lectures will be published as a booklet. More detailed information about the conference can be obtained from Dr. V. Vand, 16 Woodburn Boulevard, Bebington, Cheshire, or directly from the Society of Czechoslovakian Mathematicians and Physicists, Prague II, Žitná 25, Czechoslovakia.

THE Council of the Polish Medical Association in the British Empire is appealing for books, text-books and periodicals which are urgently needed in Poland. During the German occupation, not only were no new books published but also the existing libraries were robbed and the most valuable books confiscated. The final stages of the War practically completed the destruction. Great efforts are now being made to train young people for the work of reconstruction. The greatest difficulty encountered in this task is the lack of books and text-books. The Association is particularly interested in books on medicine, and would be glad to receive such books, in English, German or French; volumes of the *Lancet*, *Medical Officer*, *Nature*, etc., would provide university libraries with material indispensable for the work both of students and staff. Correspondence should be sent to the president, Dr. B. Jedlewski, 43 Eaton Place, London, S.W.1.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Can the Iron in Peroxidase be Replaced by Manganese?

IN 1940[1] we demonstrated that pure horse radish peroxidase can be split reversibly into protohæmin and a colourless protein component. The original activity could be restored by mixing protohæmin and the protein. Later[2], we tested different iron-porphyrins for their ability to replace protohæmin. Only deuterohæmin and mesohæmin gave activity, both lower than protohæmin. Hæmatohæmin and many others were inactive. A graph, already published[2], shows that after one mol of hæmin per mol of protein is added, further addition of hæmin does not change the activity.

Gjessing and Sumner[3] cleaved impure peroxidase preparations according to our method, and investigated the activity resulting from addition to the protein part of (1) Cu-, Co-, Mn- and Ni-protoporphyrins; and (2) Fe-meso- and Fe-hematoporphyrin.

Copper, cobalt and nickel gave no activity. Some activity (28·4 per cent) was observed in one single test with the manganese protoporphyrin, whereas remarkably enough higher and lower additions gave practically no activity. Contrary to our experience, Gjessing and Sumner's protein preparations always gave strongly decreasing activity when the hæmins were added in increasing excess. We therefore considered it of interest to see if their positive result with Mn-protoporphyrin could be confirmed. The question is important, because iron is the only metal hitherto found in peroxidases, catalases and cytochromes.

We further know from our own experience that a positive peroxidase reaction in one single test is far from conclusive, since it may sometimes be caused by unknown impurities.

We prepared Mn-protoporphyrin by heating protoporphyrin in pyridine + acetic acid + chloroform with manganese acetate. It seems never to have been crystallized (we did not succeed in crystallizing it), so it was precipitated with water or ether, washed with water and dried. Mn found = 8·2 per cent, calc. 8·9 per cent. Absorption bands in pyridine: 593 and 572–542 mμ.

Pure horse radish peroxidase was split with acetone-hydrochloric acid in ice. The protein component contained 1·8 per cent of the original activity, that was restored to 80 per cent by the addition of 100 or 200 per cent of the quantity of iron-hæmin split off. Addition of 25, 50, 100, 200 or 400 per cent manganese hæmin gave no increase over the blank value tested both one and twenty-four hours after the addition. We thus feel justified in stating that manganese-hæmin is entirely incapable of giving any activity with peroxidase protein, though a spectroscopic change showed that a reaction, probably a coupling, occurred between Mn-protoporphyrin and protein. The light absorption, measured in a Zeiss photometer, increased during the reaction in the blue (*S* 47) and yellow (*S* 57) regions.

It should finally be pointed out that contrary to our experience Gjessing and Sumner found Fe-hæmatoporphyrin to be active (max. 76 per cent) and Fe-mesoporphyrin to be even more active than Fe-protoporphyrin. The discrepancy is probably due to the fact that Gjessing and Sumner worked with impure preparations.

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Sept. 4.

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[2] Theorell, H., Bergstrom, S., and Åkeson, Å., *ibid*, 16 A, No. 13 (1943).

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Vitamin C Peroxidasic Activity

ENZYMATIC oxidation of vitamin C, first recorded in 1921[1] and made more specific since 1928 by Szent-Györgyi, has given rise to the hypothesis that the vitamin acts as a constituent of dehydrogenating enzymes. However, so far as we know, direct evidence of the enzymatic activity of ascorbic acid has not been given. Our results show that vitamin C, acting as a peroxidase or as an antioxidant, can increase or reduce the already known peroxidasic action of ionized copper[2] and iron[3]. The experiments now reported consist in a comparison between the extinction coefficients of solutions, *A*, that contain an oxidizable substrate, ascorbic acid, hydrogen peroxide, copper sulphate and ferric chloride dissolved in 10 c.c. water, and solutions, *T*, devoided of vitamin, but similar to *A* in every other respect.

The freshly prepared ferric chloride solution contains 9 mgm. citric acid to each 10 mgm. iron. The measurements of the extinction coefficients were carried out in the Pulfrich Stuffenphotometer, 10 minutes after the starting of the reaction, and refer to a layer of 20 mm. The extinction coefficients in the spectral region of wave-length 470 mμ of the solutions *A* and *T* will be designed respectively by E_A^{470} and E_T^{470}, and the difference $\left(E_A^{470} - E_T^{470}\right)$ and the ratio E_A^{470}/E_T^{470} by E_{AA}^{470} and V. E_{AA}^{470} is positive or negative and V greater or less than 1 according as the vitamin promotes or checks the oxidation; the molar (atomic for Cu and Fe) concentrations are expressed in 10^{-4} gm. per litre.

Action of the vitamin on phenol. Standard solution: phenol 2 mgm. (21 m.); ascorbic acid, 1 mgm. (6 m.); hydrogen peroxide, 3·1 mgm. (91 m.); Cu, 0·48 mgm. (8 a.); Fe, 0·01 mgm. (0·2 a.). (See Table 1.)

Solutions *A* are brown-yellow, except for solutions 2 and 5 which take a pink tint turning to brown. Solutions *T* are colourless or yellow.

Cresol (1) *and tyrosin* (2). Standard solution: (1) phenol is substituted by 2·29 mgm. (21 m.) cresol; (2) tyrosin 2 mgm. (11 m.); ascorbic acid 2 mgm. (11 m.); hydrogen peroxide 6·2 mgm. (182 m.) Cu 0·48 mgm. (8 a.); Fe 0·02 mgm. (0·4 a.). (See Table 2.)

Solutions *A* of *ortho-*, *para-* and *meta*-cresol take respectively a brown-orange, brown-yellow and pink coloration. Solutions *T* are colourless or pale yellow.

Benzidin: Standard solution: benzidin 2 mgm. (11 m.); ascorbic acid 1 mgm. (6 m.); hydrogen peroxide 3·1 mgm. (91 m.); Cu 0·48 mgm. (8 a.); Fe 0·01 mgm. (0·2 a.); acetic acid 10 mgm. per 1 mgm. of benzidin. (See Table 3.)

Solutions *A* develop immediately a brown reddish coloration. Solutions *T* first give a faint blue tint turning to reddish-brown.

According to colorimetric measurements of the red tinted chloroform extracts of solutions A_1 and T_1,

TABLE 1.

	1	2	3	4	5	6	7	8	9
Modifications	Non-modified	Asc ac 4 mgm.	Phenol 1 mgm.	Phenol 5 mgm.	Cu 0·192 mgm.	Fe 0 04 mgm.	Cu 0	Fe 0	Asc. ac. 16 mgm. Fe 0·02 mgm.
E^{470}_{AA}	+0·23	+0·43	+0·18	+0·17	+0·23	+0 61	+0 06	+0 08	−0·09
V	9	15	7	7	7	2	3	–	0 2

TABLE 2

Modifications	Cresol			Tyrosin					
	ortho-cresol	*para*-cresol	*meta*-cresol	non-modified	H_2O_2 9 3 mgm.	H_2O_2 12·4 mgm.	Fe 0	Cu 0	Asc. ac. 15 mgm. Fe 0·04 mgm.
E^{470}_{AA}	+0·28	+0 29	+0·23	+0·22	+0·27	+0·24	+0·05	−0 02	−0 31
V	10	8	6	3	6	9	4	0·9	0·2

TABLE 4

Modifications	Dopa				Pyrogallol			
	Non-modified	Cu 0 48 mgm.	Fe 0 0025 mgm.	Asc. ac. 3 mgm. H_2O_2 3·1 mgm. Fe 0·02 mgm.	Non-modified	Asc. ac. 2 mgm.	Fe 0 01 mgm.	Fe 0·02 mgm.
E^{470}_{AA}	+0·058	+0·058	+0·034	−0·115	+0·058	−0·015	+0·051	−0 007
V	5	5	1	0·8	2	0·7	2	0·9

TABLE 3

	1	2	3	4	5
Modifications	Non-modified	Asc. ac. 0·5 mgm.	Ascorbic acid 0 5 mgm. Cu = 0	Fe = 0	Cu, Fe = 0
E^{470}_{AA}	+1·40	+1·20	+0·43	+0·24	0
V	4	3	4	4	1

with 2 mgm. of benzidin, 0·35 mgm. in the solution *A* nd 0·09 mgm. in the solution *T* are converted at he tenth minute of the reaction into the benzidin i-equivalent oxidized product, the diphenoquinone is-acetate-imide, $C_{12}H_{10}N_2(COOH-CH_3)_2$.

3–4 *Dioxyphenylalanin, called 'Dopa'* (1), *and yrogallol* (2). Standard solutions: Dopa 2 mgm. 10 m.); ascorbic acid 1 mgm. (6 m.); hydrogen eroxide 1·55 mgm. (46 m.); Cu 0·24 mgm. (4 a.); Fe = 0. (2) Pyrogallol 2 mgm. (16 m.); ascorbic cid 1 mgm. (6 m.); hydrogen peroxide 0·31 mgm. 9 m.); Cu 0·192 mgm. (3 a.); Fe = 0. (See Table 4.)

The Dopa *A* solutions take a brown coloration. olutions *T* develop a faint blue tint turning to the rown. Solutions *A* and *T* of pyrogallol give a brown nd pale yellow coloration.

The results of this investigation may be summarized s follows. Vitamin C and ionized copper and iron onstitute a monophenol peroxidase, while the vita- in and copper give a polyphenol peroxidase. The bserved activity of vitamin C seems, however, not o be exclusively limited to the transport of hydrogen, ut may also involve a deep modification of the henol molecule as suggested by the appearance of pink coloration in phenol solutions.

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HELÈNE LEROUX.

Clinique Infantile
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repliée à Clermont-Ferrand.
June 11.

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Hæmoglobin in Blood-sucking Parasites

THE hæmoglobins of different animals are not identical; the differences between them could be used as specific characters within a genus. In *Daphnia*, for example, the axes of the α-bands of oxyhæmoglobin, measured with the Hartridge reversion spectroscope, are at 5761, 5764 and 5766 A. in *D. obtusa* Kurz, *D. pulex* (De Geer) and *D. magna* Straus respectively, while for the larvæ of two species of the chironomid genus *Anatopynia*, the wave-lengths are 5769 for *A. varia* (Fabr.) and 5776 for *A. nebulosa* (Mg.). Moreover, hæmoglobins are not only specific: they also may be individual[1]. It is to be expected then that the hæmoglobins of a host and of its bloodsucking parasite will not be identical; yet this seems never to have been established. The only invertebrate parasites which suck the blood of vertebrate animals and have hæmoglobin in their own blood are certain leeches and copepods, and it has been supposed by some that the hæmoglobin of a parasitic copepod originates from that of its host, a fish, by passing through the gut wall of the parasite and accumulating in the blood of the latter[2].

There are two types of parasitic copepod with red blood, represented by *Lernanthropus* and *Lernæocera* (*Lernæa*). Van Beneden[3] in 1880 showed with the spectroscope that the blood pigment of the former is hæmoglobin; but the pigment of the latter has not hitherto been identified. Through the kindness of Miss N. Sproston and Mr. C. F. Hickling I have been able to examine the blood of *Lernæocera branchialis* (L.) from the gills of the greater forkbeard, *Urophycis blennoides* (Brünnich). The parasite's blood contains hæmoglobin, and the axis of the oxyhæmoglobin α-band is at 5790 A. (Hartridge spectroscope). That of the host's oxyhæmoglobin is at 5765 A. The two hæmoglobins are thus not only different, but also very different from one another. Among thirty-one species of animals examined, the wave-length of the oxyhæmoglobin α-band was found to be longest in *Lernæocera branchialis* and shortest in *Isidorella gibbosa* (Gould), a freshwater pulmonate snail from New South Wales. The α-band in this mollusc is at 5751 A., while in man it is at 5775 A.

It would be interesting to know the value, if any, of hæmoglobin to copepods, and whether there is a functional reason for its presence in some copepod parasites of fish and absence in others. Experimental work may solve the problem, but meanwhile it is not justifiable to assume[2] that in *Lernæocera* oxygen for respiration reaches the parasite through its mouth with the host's hæmoglobin, and that direct gas exchange between copepod and sea water is reduced to a minimum because the cuticle is relatively thick. Such a source of oxygen from the host is improbable, particularly when, as pointed out by the authors quoted, the parasite's meals are taken at rare intervals.

H. MUNRO FOX.

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July 19.

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Œdema in Hamsters Infected with *Leishmania*

IN the course of work upon the chemotherapy of experimental kala-azar, I have observed that Syrian hamsters (*Cricetus auratus*) with long-standing infections of an Indian strain of *Leishmania donovani* sometimes develop severe œdema. Ascites and distension of the mesentery with fluid are the first signs of the condition. Later, gross œdema of the subcutaneous tissue develops and the skin is pulled down into a skirt around the flanks by the weight of the fluid it contains. The animal increases rapidly in weight through water retention and dies in a few days. An adult hamster weighing 80–100 gm. may gain 50 gm. in weight in the course of a week.

When this observation was first made in 1942, private correspondence with the late Dr. G. W. Dunkin of the Agricultural Research Council, who supplied the hamsters, confirmed the fact that the condition had not been recognized in stock animals.

The condition appears only after several months of infection with leishmania, and not every animal is affected. It does not depend upon the degree of infection as measured by parasite counts in spleen smears[1]. Œdematous animals are not suitable for use in tests for leishmanicidal substances, and the difficulty has been overcome by the use of recently isolated Mediterranean strains of leishmania, which produce heavy spleen infections in the course of a few weeks[2]. However, if animals infected with these strains are kept untreated for several months, some of them develop œdema. This shows that the condition is not associated with a single strain of leishmania.

Œdematous animals exhibit proteinuria; the kidneys are pale and enlarged, and histological examination shows degeneration of the glomeruli and obstruction of the tubules with protein casts. The serum protein in a few animals was determined by Walther's method[3]; the results for five œdematous animals were: 3·8, 5·4, 4·6, 3·5, 4·9 per cent of protein respectively, and for two normal animals of the same age, 7·1 and 7·6 per cent. It is evident that severe loss of protein through the kidney is the chief cause of the œdema.

All attempts to cultivate a secondary infective agent upon nutrient media or by inoculation of normal animals have so far failed. Intraperitone and intracerebral inoculations into mice and hamster, and inoculation of chick tissue-cultures with a candle suspension of kidney, liver or spleen material fro œdematous hamsters have also been without resul It seems probable that the nephritis is caused by toxin liberated by the leishmania parasite und conditions of chronic infection.

The condition of the hamsters recalls that observe in mice infected with *Trypanosoma cruzi*, which h been investigated by Collier, Fulton and Innes[4]. Th underlying cause of the œdema is not, however, th same, because these workers found the kidneys œdematous mice to be normal.

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Production of *p*-Aminobenzoic Acid b the Tubercle Bacillus

MANY workers have claimed that the commo sulphanilamides in high concentrations may modif the course of experimental tuberculosis in animal Much better results have been obtained, however with the diaminodiphenyl-sulphone and some of it derivatives, for example, promin and diasone. Th same applies to promizole, an analogous compound which is a diaminophenyl-thiazole-sulphone. Thes sulphones have also shown a certain effect in a prolonged clinical trial, although it is necessary to see for more effective, or at least less toxic, compounds

The diaminodiphenyl-sulphone and similar compounds are said to act on sensitive bacteria in th same manner as the sulphanilamides. The fundamental condition for the effectiveness of these compounds against the tubercle bacillus would therefor appear to be that this bacterium also requires *p*-aminobenzoic acid as an essential metabolite. Indirec proof of this is furnished by the observation that th bacteriostatic action *in vitro* of sulphathiazole[1] an promin[2] on the tubercle bacillus is inhibited b *p*-aminobenzoic acid. We have, however, performe direct analyses[3], and succeeded in showing that bot the tubercle bacillus and the culture medium i which it has been grown contain *p*-aminobenzoic acid Assuming that *p*-aminobenzoic acid is of function significance to the bacterium which forms it—an this is highly probable—the experiments with sulph ones and related substances in experimental tuberculosis can therefore be considered as well founde

The determinations were performed in the followin manner. A number of flasks, each containing 200 m of Sauton's synthetic substrate, were inoculated wit a virulent human strain (a platinum loop containin on the average 0·1 gm. of wet bacilli). The culture were incubated at 37° C. for different times. Th resultant cakes of bacteria were finely dispersed an washed and dried by suction. The filtrate wa sterilized by heat (passage through a Seitz filter di not alter the values) and continuously extracted wit ether at *p*H 3·8 for 30 hours. *p*-Aminobenzoic aci was determined colorimetrically in the ether solutio

Time of cultivation (days)	Amount of p-aminobenzoic acid formed in substrate. (μgm. per flask of 200 ml.)			Amount of moist bacteria formed. (gm. per flask of 200 ml.)	Amount of p-aminobenzoic acid formed in bacteria. (μgm. per gm. moist bacteria)		
	Without hydrolysis	After alkaline hydrolysis†	Total		Without hydrolysis	After alkaline hydrolysis†	Total
5	2·0	0·5	2·5	0·3	—	—	—*
10	2·5	1·1	3·6	1·3	—	—	—*
30	6·5	2·0	8·5	3·9	0·3	0·6	0·9

* Quantity of bacteria too small for exact analysis.
† A more intense hydrolysis may perhaps give higher values.

with p-dimethylaminobenzaldehyde[4]. The residue from the ether-extraction was made normal with respect to sodium hydroxide and autoclaved for 30 minutes at 15 lb. pressure for the liberation of the bound form of p-aminobenzoic acid[5]. Alkaline hydrolysis is more effective here than acid hydrolysis. The hydrolysate was extracted with ether in the manner described above.

The washed bacteria were autoclaved with ten parts of water at the same pressure and for the same ime as above. The free p-aminobenzoic acid was determined in the filtrate. The remaining bacteria were treated in the same way with ten parts of normal sodium hydroxide in order to liberate the conjugate form of p-aminobenzoic acid.

All reagents and the constituents of the culture medium were free from p-aminobenzoic acid. The method may be regarded as rather specific; of the substances which might be thought to give a disturbng effect, tryptophan produces another colour and kynurenin is not extractable at pH 3·8[6].

The values obtained are given in the table, from which it follows that p-aminobenzoic acid is formed and excreted by the tubercle bacillus. It is an interesting point that larger quantities are found in the substrate than in the bacteria themselves. It would also seem that the proportion of p-aminobenzoic acid in the free form is higher in the substrate than in he bacteria.

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May 3.

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Theory of the Formation of Hydrochloric Acid in the Gastric Mucosa

IN a previous communication[1], the formation of a igh degree of acidity (pH 1·7–1·8) during fermentaion by ordinary bakers' yeast was described. Acid ormed to this extent in the suspending fluid (0·6 part o 1·0 of yeast) when unbuffered and containing potassium chloride of about 0·1 M strength or more. The mechanism of the formation consisted in an organic acid—such as pyruvic or phospho-pyruvic cid—exchanging its hydrogen ions for the external otassium ions. In this way an external hydrochloric cid content of about $N/50$ was developed. A similar mechanism for gastric hydrochloric acid was indicated, and throughout 1943–44 many experiments were carried out on human subjects after test meals, blood and gastric contents being analysed. Experiments were also carried out on rats and rabbits, the results being presented by one of us in a thesis on "Studies in the Relation of Keto-Acids to the Secretion of HCl by the Gastric Mucosa"[2].

Meanwhile, a more extended study of the occurrence in yeast appears to indicate that the acidic system involved is not mainly the pyruvic, but includes at least some other acid closely related thereto in the metabolic chain.

Owing to the publication this year of a paper by Bull and Gray[3] outlining a theory of hydrochloric acid excretion by the stomach, in some respects similar to that worked on since 1943 by us, attention is here directed to the latter and the work done in relation thereto. In our view the essential process consists in the secretion first of potassium chloride solution of about isotonic strength into a membrane lined tubule (which may be identified with the canaliculus in the parietal cells). As it passes along the tubule an exchange of hydrogen and potassium ions occurs, just as occurs in fermenting yeast with potassium chloride outside. The necessary organic acid is assumed to be formed in localized cell regions impinging on the canaliculus. No assumptions need be made throughout of a permeability other than that holding (say) for the muscle fibre membrane[4] or the yeast cell. With this view the movement of hydrogen ions across the membrane is apparently more effective than back into the cell; but again this also appears true for the yeast transfers, though another explanation may be more correct than a difference in velocity of passage. As the potassium ions pass back into the cell, the organic acid anions are continuously removed by oxidation, leaving bicarbonate ions in association with potassium ions and much free carbon dioxide. We may suppose K and HCO_3 ions passing across the boundary of the cell, because there the product of their concentrations is greater than outside; but as K and Cl are being extruded into the canaliculus, we may regard the events for the K ions as a circulation in the cell, with HCO_3 exchanging for Cl ions across the cell boundary.

A point of much importance arises in connexion with the formation of carbon dioxide by decarboxylation. It is generally taken for granted that the free gas is directly formed, but for yeast carboxylase at least, this can be shown to be incorrect[5], carbonic acid being first produced. As the process of decarboxylation is very likely similar for the animal cell, we may suppose carbonic acid also formed from keto-acids. Where there is an exceptional degree of activity associated with keto-acid breakdown, the presence of carbonic anhydrase would appear to be useful in hastening the change to carbon dioxide as the $KHCO_3$ diffuses back. This theory has the advantage over others in that there is a readily producible biological model forming free hydrochloric acid in an essentially similar way, and no other permeabilities need be assumed than those observed for the muscle membrane[4].

Seeing that free carbonic acid is produced in decarboxylation, the idea may be entertained that, after all, it is this acid which provides the free hydrogen ions. Our present reasons for supposing that this is not the main source (and it may be certainly held to provide some fraction) is that the true first ionization constant of carbonic acid given as around $10^{-3.5}$ does not appear sufficiently high unless strong concentrations of the acid are localized. Secondly, even *in vacuo* the high formation of acid in the external fluid proceeds with fermenting yeast, and the total carbon dioxide is reduced to a low figure. More experimental work is, however, required in this connexion.

The theory will be discussed more fully elsewhere.

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O. FitzGerald.
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July 4.

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A Neutral Solvent for Melanin

Melanin from the ink sac of *Sepia officinalis*, from a melanoma, and that prepared by the action of tyrosinase on tyrosine has been found to be soluble *in the cold* in ethylene chlorhydrin, $CH_2Cl.CH_2OH$.

Previously melanin had been thought to be soluble in diethylamine, but further investigation showed that in fact the solvent had combined with water vapour to form an alkyl hydroxide, and the resulting solution was strongly alkaline. It was also thought that 1 : 2-dihydroxypropane was a solvent, but on evaporation it was found that the resulting blackish-brown substance no longer had the properties of melanin. In the case of ethylene chlorhydrin the solution is neutral, and the substance remaining after evaporation is indistinguishable from the original melanin. The solubility increases with heat, and no change has been detected in the recovered melanin after treatment with the solvent in a Soxhlet extractor.

No guarantee of the purity of the melanin being possible, no attempt has been made to determine the precise degree of solubility, but it is very evident that both tumor and *Sepia* melanins are much more soluble than that obtained from tyrosine. No conclusions can be drawn from this fact, as it is not possible to state whether the tumor and *Sepia* melanins are or are not combined with a protein.

The work has been carried out with the aid of a grant from the Government Grant Committee of the Royal Society.

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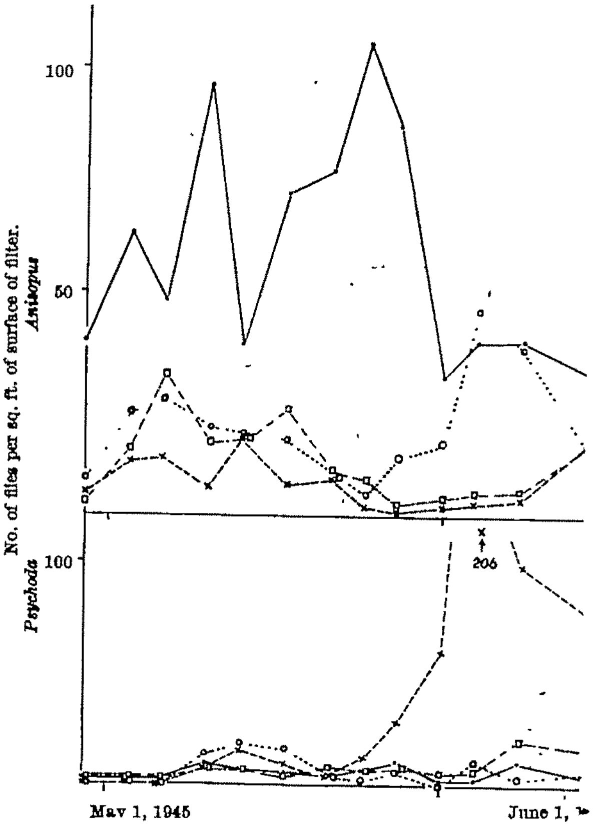
Control by D.D.T. of Flies Breeding in Percolating Sewage Filters

Nuisance often arises from the emergence of large numbers of flies from percolating filters treating sewage, situated near dwelling-houses or busy thoroughfares. Species which have caused most trouble are *Anisopus fenestralis*, *Psychoda alternata* and *Psychoda severini*. Various methods of control have been tried, including treating filters with creosote or bleaching powder, and flooding the filters with sewage; flooding can only be used, however, where the construction of the filter is suitable. The toxic substances so far used are non-selective in thei action; the concentrations necessary to kill fly larvæ also kill other members of the valuable population of scouring organisms, such as Collembola and enchytræid worms, as well as bacteria and fungi which form the active biological film on which th purifying efficiency of the filter depends.



Nos. of *Anisopus* and *Psychoda* trapped on percolatin sewage filters treated with creosote, bleaching powde and D.D.T.

		Date of treatment
• ——— •	Control	
× - - - - ×	Creosote	April 24
o ········ o	Bleaching powder	April 16
□—·—·□	D.D.T.	April 26

Experiments on the treatment of small experiment filters with D.D.T. in the form of (*a*) a powder applie at a rate of 300 lb. of D.D.T. per acre, and (*b*) a emulsion of D.D.T. in naphtha or kerosene at a ra of application of 50–100 lb. of D.D.T. per acre, showe that more than 90 per cent of the larvæ of *Anisopu* and *Psychoda* were killed, but that the Collembo and enchytræid worms were unaffected. Prelimina tests show that D.D.T. in these concentrations is no toxic to the bacteria and fungi in a filter, and th has no deleterious effect on its purifying capacity. The accompanying graph shows the results of an experiment on a large scale at the Minworth Works of the Birmingham Tame and Rea District Drainage Board. During the period April 16–26, 1945, filters were treated with the following substances: creosote 400 gallons per acre), bleaching powder ($6\frac{1}{2}$ tons per acre), and D.D.T. in the form of emulsion (75 lb. D.D.T. per acre); the numbers of emergent *Psychoda* and *Anisopus* flies caught in standard traps on the surface of the filters were then observed. Treatment with creosote gave the greatest reduction in numbers of *Anisopus*, but all the scouring organisms in the filter were killed and the biological film which later accumulated supported a secondary population of *Psychoda*. Bleaching powder caused the biological ilm to be discharged from the filter, and later there was a secondary peak in the emergence of *Anisopus*. With D.D.T. the numbers of both flies were greatly educed and an active population of worms (*Pachytrilus lineatus*) and Collembola (*Achorutes viaticus*) remained and kept the growth of biological film in check.

Further experiments are being made, particularly to ascertain the minimum quantities of D.D.T. and the best method of application to control filter flies. At present D.D.T. is not available for civilian use; the possibility of applying it for control of flies at sewage works would, of course, depend on its price in comparison with the cost of alternative poisons.

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July 21.

Use of Hydrochloric Acid for Softening Algal Tissues for Microtome Sections

In view of the increasing interest in marine algæ it seems apposite to record a method of treatment which has been found useful in preparing microtome ections of some Florideæ with particularly firm thalli. Formalin-alcohol, although a good fixative or cytological purposes, tends to harden such thalli, making them difficult to cut by microtome. Moreover, in those species which have an abundance of mucilaginous substances between the cells, the sections, when floated on water, swell considerably, twist, and escape from their casing of paraffin-wax. These difficulties can be avoided by treatment with warm ydrochloric acid in the case of *Chondrus crispus*, *Gigartina mamillosa*, *Gracilaria confervoides* and *Rhodymenia palmata*.

The method of treatment has been to put a covered dish containing a mixture of 90 c.c. of 70 per cent alcohol and 10 c.c. of hydrochloric acid in the embedding oven. When the liquid has reached the temperature of the oven, the piece of thallus to be eated is transferred to it from 70 per cent alcohol. he duration of the treatment required by different materials can only be found by experiment as it aries not only from species to species, but from the ounger portions of the thallus to the older. For example, young pieces of *Gigartina mamillosa*, after fixation in formalin-alcohol, require 15 minutes, hereas similar pieces of *Chondrus crispus* require nly 5 minutes. The duration of treatment should e kept to the minimum as continued immersion interferes with the staining of the nuclei and ultimately causes disintegration of the thallus. After treatment the thallus is washed thoroughly in 70 per cent alcohol and embedded in the usual way.

Of the algæ mentioned above, *Gracilaria confervoides* cuts reasonably well untreated, but sections of treated material are definitely superior. *Gigartina mamillosa* is very difficult to cut untreated after fixation in formalin-alcohol, but the youngest portions of the frond can be cut without treatment after fixation in Karpechenko's fluid. Even so, better results can be obtained by the use of hydrochloric acid. This is indispensable for the older parts of the frond, fixed in Karpechenko's fluid, but the time required is shorter than after formalin-alcohol. The improvement in all cases is more marked with sections cut at 5 µ than at 10 µ.

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Aug. 18.

Activation Energy of Ionic Migration in Molten Salts

The conductivity of ionic melts, such as alkali and alkaline earth halides, can be represented fairly well by an equation $\varkappa = Ae^{-C/RT}$, where C may be regarded as the energy necessary to effect the configurational change occurring in ionic migration. Deviations from this equation, C varying with temperature, are found with some salts of a partially covalent character, for example, zinc chloride and lead chloride; with these salts, constitutional changes, such as dissociation, are likely to occur on rise of temperature.

The viscosity of ionic melts can be represented approximately by a similar equation: $\eta = A'e^{B/RT}$, where B is the energy necessary to produce the configurational change in viscous flow. Here also deviations have been recorded with some compounds of a partially covalent character[1]. Tabulated values for B[2] and C[3] are shown below.

	Equiv. conduct. (temp. 10 per cent above melting point [abs.])	C in cal./mole	B in cal./mole	r_A/r_C
LiCl	181	1150	8800	3·01
NaCl	149	1540	9400	1·91
KCl	120	2300	7800	1·36
RbCl	95	2830	—	1·22
CsCl	82	3330	—	1 07
NaBr	145	1840	10600	2·05
KBr	105	2550	7960	1·47
NaI	150	1250	7400	2·27
KI	106	2750	9200	1·62
$CaCl_2$	65	4100	9500	—
$BaCl_2$	78	4150	—	—

The activation energy of viscous flow (B) is always greater than that of ionic migration (C). This must be due to a difference in mechanism between the two processes. Viscous flow is determined to a greater extent by the large anions than by the small cations. On the other hand, the electric conductance of the alkali halides is mainly due to the small cations, while the contribution of the large anions is very much smaller[4]. This is shown by the fact that the equivalent conductivity changes strongly with change of cation but very little with change of anion. These salts are predominantly cation-conductors in the solid state also[5].

Thus, viscous flow involves a more far-reaching configurational change and higher energy barriers than ionic migration. It is therefore not surprising that there is no simple relation between conductivity and viscosity of molten salts. For example, the temperature coefficients of the two properties are not equal.

With the alkali chlorides there is a distinct increase of the activation energy (C) from lithium to cæsium, together with a decrease of the ratio of anion to cation radius (r_A/r_C). The small values for lithium chloride and sodium iodide are probably due to comparatively small energy barriers in systems in which r_A/r_C is great; in the case of lithium chloride, the small cations must have considerable freedom of movement between the large anions in contact.

The C-values of the alkaline earth chlorides are greater than those of the alkali chlorides because of the stronger electric field in an assembly containing bivalent ions, and also because these molten electrolytes—by analogy with the solids[5]—may be expected to be anion conductors.

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April 12.

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[1] Ward, A. G., *Trans. Farad. Soc.*, 33, 88 (1937).

[2] Most values taken from Barrer, R. M., *Trans. Farad. Soc.*, 39, 48 (1943), others calculated from data by Karpachev, S., and Stromberg, A., *J. Phys. Chem.* (*U.S.S.R.*), 11, 852 (1938).

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[4] Frenkel, J., *Acta Physicochimica U.R.S.S.*, 6, 341 (1927).

[5] Cf. Mott, N. F., and Gurney, R. W., "Electronic Processes in Ionic Crystals" (Oxford, 1940).

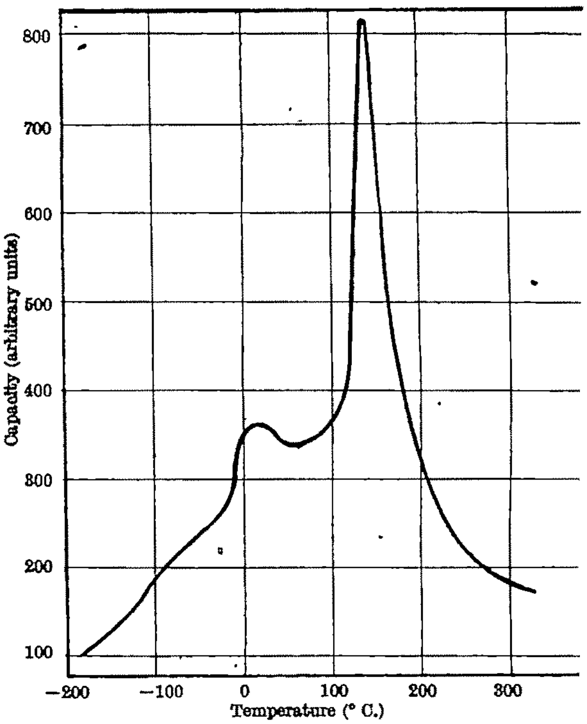
Dielectric Constants of Some Titanates

THE oxides and carbonates of beryllium, magnesium, cerium, zinc, strontium, cadmium and barium were heated with titanium oxide to a temperature of about 1,500° C. The dielectric constants of the titanates thus obtained were, for beryllium titanate 70, for magnesium 17, for calcium 115, for zinc 30, for strontium 155, for cadmium 62, exceeding 1,000 for barium. The measurements were carried out at room temperature at a frequency of 1 M Hz.

The titanates may be divided into two groups according to their place in the periodic system and the values of their dielectric constants. The titanates of beryllium, calcium, strontium and barium belong to the first group, and those of magnesium, zinc and cadmium to the second one. Such a division in general coincides with the division of the titanates according to the type of their crystal lattice. The crystal lattices of the titanates of calcium, strontium and barium are of the perovskite type, whereas those of magnesium and cadmium are of the ilmenite type. The atomic or ionic polarizability depends upon the structure of the crystal, and for this reason the magnitude of the dielectric constant depends upon the type of the lattice.

The dielectric constants of the perovskites investigated were found to grow with the increase of the size of the alkaline-earth ion. The electron polarizability of the ion increases with the radius. A more important factor, however, is that with the increase of the radius of the alkaline-earth ion located in the centre of the elementary cell, the distance between the titanium and oxygen ions increases as well.

Barium titanate having a very large dielectric constant, the distance between the titanium and the oxygen ions exceeds the sum of their radii. Such a 'loose' structure of the crystal lattice leads to considerable atomic polarizability.



The dielectric constant of barium titanate varies considerably with the temperature. The variation of the capacity of a barium titanate condenser with the temperature is shown in the accompanying graph.

The present investigation was carried out with J. M. Golgman. A more detailed article will be published in the *C.R. Acad. Sci. URSS*.

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Moscow. June 18.

A Photographic Method of Deriving Isoclinics in Photo-elastic Methods

IT is well known that the chief cause of inaccurac in the photo-elastic method of stress analysis lies i deriving the isoclinics. We have used a photographi method which has greatly improved the accurac with which the isoclinics can be drawn. It consist of varying the load on the model so as to blur ou the isochromatic pattern (mercury green), leaving th isoclinics superimposed on a uniform grey background. The intensity of the light source is so adjuste as to enable a 30-sec. exposure of the photographi plate to be given, and the load is varied between quarter and three-quarters of the full load used t take the isochromatic pattern. The reduction t three-quarters of full load is advisable to prever fatigue failure. The model is carried through thr complete cycles during the exposure.

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SOCIETY FOR APPLIED BACTERIOLOGY

AT the annual summer conference of the Society of Agricultural Bacteriologists, which was held at the Midland Agricultural College during July 23–25, plans were approved for a change in the title and range of interests of the Society. It has now been renamed the Society for Applied Bacteriology.

For some years the Society has, in fact, ceased to confine its interests entirely to the agricultural field and has attracted to its membership bacteriologists working in such fields as water supplies, sewage disposal, fisheries, food manufacture and various industries, as well as those in academic institutions whose work brings them into contact with the applied aspects of the subject. The inauguration recently of the Society for General Microbiology has fortunately provided a common meeting-ground for the discussion, by microbiologists working in all fields, of the more fundamental aspects of the science. There is, however, a large number of bacteriologists for whom hitherto no adequate society has existed, and whose needs are only partially satisfied by discussions at the 'fundamental' level. At a time when scientific men are being called upon more than ever to contribute to improvements and new processes in various industries, it is essential that those working in applied bacteriology should have facilities for meeting and discussing matters of mutual interest.

Membership of the Society for Applied Bacteriology is open to all who are interested in bacteriological problems. It is intended to hold an annual conference in the summer at different centres in the British Isles, and a shorter meeting in London in the winter. For the time being, papers, or abstracts of papers, will be published in the *Proceedings* of the Society. It is hoped that eventually the Society's publication will increase to the size of a journal. The officers of the Society are: *President:* Dr. L. A. Allen, Water Pollution Research Laboratory, Watford; *Secretary:* Mr. D. A. McKenzie, Provincial Laboratory, 36 Otley Road, Leeds; *Treasurer:* Mr. L. J. Meanwell, United Dairies (Wholesale), Ltd., Ellesmere; *Editor:* Mr. A. Rowlands, National Institute for Research in Dairying, Shinfield, Reading. The annual subscription is at present one guinea.

A survey of the papers at the summer conference follows.

A paper dealing with the teaching of bacteriology emphasized its unassailable claim to be taught as a science; its students are trained as bacteriologists in the widest sense, able to apply their knowledge and experience to any and every problem of a bacteriological nature, and not restricted to the relatively narrow field of its applications to some other science. With this ideal in view, a plea was made for the establishment at universities of independent departments of bacteriology, with the provision of a science degree, or at least a diploma, in bacteriology. A suitable curriculum was outlined together with observations on the teaching methods that should be applied, a distinction being drawn between the requirements of those intending to follow a career in bacteriology, and others for whom a knowledge of its applications in their own particular sphere was the only essential.

The origin and development of the National Collection of Type Cultures was described, together with an account of its organization and work. In view of the facilities now provided for the microbiologist by the type culture collections, their future is of considerable importance, and the problem was thoroughly discussed.

A contribution dealing with bacterial growth in aerated and quiescent flax infusion described the chemical changes produced. With quiescent cultures, the liquor obtained is acidic in nature, frequently containing appreciable amounts of volatile acids. Industrially, such a liquor tends to be evil-smelling, difficult to treat for purposes of disposal, and unsuitable for re-use in an industrial process. With aerated cultures, on the other hand, the reaction tends to become alkaline, with a much smaller and sometimes negligible content of volatile acids. Reduction of the organic carbon content, which as shown by the carbon balance sheet can be accounted for by the carbon dioxide produced by bacterial action, is reflected in a reduction of the polluting strength as shown by the usual methods of measurement.

A study of the microflora of immersion brines emphasized the many problems that require elucidating, not only as regards the curing process itself, but also as regards the bacteriological technique to be applied in studying the bacteria involved.

Water supplies used for dairy purposes at many Welsh farms and dairies were shown to be heavily polluted, and their purification by chlorination has been investigated. The residual bacterial flora of tap, well and clear river water was in all cases negligible following treatment for ½ hr. with 10 p.p.m. chlorine. A 2 hr.-contact period using 50 p.p.m. chlorine was necessary to attain similar results with turbid river water. False-positive presumptive coliform results obtained with chlorinated stream water were caused by an organism resembling *Bacillus polymyxa*.

Further evidence of the value of a modified Hotis test (plating Hotis-positive samples on crystal violet blood agar), not only in reducing the work involved, but also in increasing the number of positive samples, was adduced from the results of the examination of 639 quarter samples known to be, or suspected of being, infected with *Streptococcus agalactiae*.

Methods for the bacteriological examination of milk continue to receive much attention. In a discussion of the choice of a suitable yardstick for evaluating tests, it was pointed out that no single test at present available is adequate to cover the whole range of producer, distributor and consumer requirements. A further paper dealt with the effect of temperature variations in the region of 37·5° C. on the reduction of methylene blue and resazurin in milk. Results show that at temperatures between 31° C. and 43° C., the acceleration of reducing action and the gradual inhibition of bacterial growth in milk by increasing temperatures more or less cancel out, mean differences in reduction times being well inside the experimental error of about ½ hr.

With the introduction of the National Milk Testing and Advisory Scheme, bacteriological tests and standards for the examination of washed churns were prescribed. Towards the end of 1944, 5,400 churns at 1,110 milk depots in England and Wales were being tested monthly by these methods. Results obtained in Wales showed that mechanically washed churns were, in general, bacteriologically more satisfactory than those washed by hand and then steamed over a jet, although at dairies dealing with a small number of churns daily (less than fifty), which allows of adequate time for steaming both lids and churns, equally satisfactory results were obtained.

The effect of contamination from churns on the bacteriological and keeping quality of both raw and pasteurized milk was the subject of another paper. There is in general no measurable effect, unless the number of bacteria added by the churns is at least equal to that initially present in the milk. Churns which have been mechanically washed efficiently are without effect on the keeping quality of the milk, and no advantage accrues from further steam sterilization of such churns.

The *Proceedings* of the Society, containing full abstracts of the papers read at the conference, may be purchased from the honorary treasurer.

BRITISH ELECTRICAL ENGINEERS AND THE WAR

AT the opening meeting on October 4 of the current session of the Institution of Electrical Engineers, Dr. P. Dunsheath delivered his presidential address, in the course of which he gave a broad survey of some of the contributions made by British electrical engineers to the successful outcome of the greatest war in history. The scope of the address was very wide and covered such subjects as the maintenance of the electric power supply of Great Britain, the considerable increase in communications both at home and overseas, the use of broadcasting and radar as defensive and offensive weapons, the defeat of the magnetic mine, radio aids to navigation and gun-laying, the improvement of searchlights and the development of electrical equipment for research on atomic energy. The success attained in all this work was in no small measure due to the extensive and ready co-operation which was built up between the Services and the electrical industry for the purpose of solving the many problems of design and production which continually arose. In giving some general facts about the above contributions, Dr. Dunsheath disclosed some striking figures concerning the various phases of electrical engineering as adapted to war-time requirements.

The problem of the maintenance of an adequate electric power supply had to be tackled in the face of such difficulties as the destruction of, or severe damage to, certain generating stations by enemy bombing, and the interruption of service due to the breakdown of the overhead wires of the Grid system. The large majority (about 73 per cent) of the faults on this overhead distribution system were caused by trailing cables of barrage balloons which had broken loose; and only some 14 per cent were directly attributable to enemy action. For strategic reasons it became necessary early in the War to effect a major transfer of munition works to South Wales and the south-west of England; and the resulting change in load distribution imposed a very onerous task on the national control organization of the Central Electricity Board. Having in mind the additional difficulties of obtaining materials, suitable coal and adequate labour, there can be no question that the successful operation of a system of public supply stations with an output in 1944 of more than 38,000 million kWh., which was an increase of nearly one half on the 1939 output, is an outstanding performance.

As the supply of electric power for industrial purposes was a prime war-time necessity, so was the maintenance and extension of communications between different parts of the country and overseas In this field the British Post Office provided a vast private-circuit network for the operational, meteorological and administrative traffic of the Fighting and allied Services, and enlarged its peace-time trunk system to reduce delays in priority traffic concerned mainly with the supply of munitions. Much progress was made during the War in the equipment used on audio carrier current and coaxial cable systems with the object of making each circuit carry as many communication channels as possible. Where it was necessary or expedient, radio links operating on ultra short wave-lengths were installed and used as an integral part of the land-line network. In spite of various precautions taken before and during the War many disasters due to enemy action overtook the Post Office. For example, a single high-explosive bomb on the Old Bailey on May 10, 1941, severed 28 cables of different types and interrupted 5,200 working circuits, mainly long-distance.

Overseas communications for the Services, necessarily of a secret nature, were carried out mainly by the submarine cable system, a network of 155,000 nautical miles which suffered many vicissitudes during the War due to enemy action and other causes. The enormous quantities of Press traffic, etc., were mainly cleared on wireless circuits; and on the long-distance service an outstanding war-time technical development was the extension of relay working to avoid interruption of the service by unsuitable ionospheric conditions. Another remarkable development in British electrical engineering enterprise during the War was in connexion with the wireless transmission of photographs, drawings, etc. Although the whole of the London photo-telegraph apparatus was lost during the raids of May 1941, the number of circuits on which photographs can be transmitted has been increased from three to eleven, and some two thousand facsimiles are now being exchanged monthly over direct circuits between London and the principal cities of the world.

The British broadcasting service was outstanding during the whole of the War in providing entertainment, news and stimulating programme items so necessary in keeping public morale at a high level In addition, an important job, not perhaps adequately appreciated by British listeners, was carried out in providing listeners in the occupied countries of Europe with their only access to truth in news and their only means of contact with the world outside Nazi domination. As a result of the war-time effort of our electrical engineers, Great Britain now possesses the world's largest long-wave broadcasting station capable of delivering to the aerials a power of 800 kW. as well as the world's largest short-wave broadcasting station, at which there are twelve transmitters, each capable of delivering 100 kW. to one or other of th fifty-one directional beam aerials. In order to improve home reception and to provide for local broadcasting in the event of the interruption of communications due to invasion, the B.B.C. built sixty-four small broadcasting stations, which were synchronized and operated on one wave-length—an outstanding technical achievement. These were finally closed on July 28, 1945, when the Corporation changed over to the first instalment of peace-time broadcasting.

During his address, Dr. Dunsheath referred at som length to the development and applications of radar both as a defensive and as an offensive instrumen of war. This technique, developed first as a means of detecting attacking enemy aircraft, and later used as an entirely novel form of navigation and for the precision bombing of enemy targets on and, sea or in the air, is now well known as one of the outstanding achievements of the War, in which scientific workers, engineers, industry and the Services have co-operated with complete success. This work brought in its train remarkable developments in the technique and output of valves, cables with novel dielectrics, cathode ray tubes and many other components. The facts that a modern battleship carries about fifty transmitting sets of various kinds, and many more receiving sets, and that a Lancaster bomber fully equipped may require about four hundred valves, accounts for the statement that during the last year of the War thirty-eight million thermionic valves were produced for the Services as compared with a peace-time demand of a quarter of a million.

There are many other electrical engineering applications which have been exploited to the full during the War, such as the clearing of fields of magnetic mines and the fitting of ten thousand warships and merchant vessels with degaussing equipment, the improvement of searchlights and their automatic direction by radar control, and the lighting of ports, shipyards and other important open areas under conditions of severe restrictions.

Dr. Dunsheath was only able to make a passing reference to the importance of the corporate work of the Institution of Electrical Engineers, and to the teaching profession, in providing an adequate supply of trained and experienced personnel of all grades. Without the assistance of large numbers of trained personnel, many of the engineering and scientific achievements of the electrical engineer during the War would never have come to fruition.

SCIENTIFIC STUDY OF FELLMONGERING

THE wool trade and, later, the cloth trade are the two industries on which the wealth of medieval England was founded, and wool production is still one of the leading industries of the British Empire. Though large quantities of wool are taken from the living sheep at the annual shearing, a good deal comes from slaughtered sheep. The handling of the sheepskin after flaying, and the separation of the wool from the pelt, are the tasks of the fellmonger, who in many cases is carrying out his work to-day by the same methods as those employed by his ancestors hundreds of years ago. Fellmongering, however, like a number of other ancient crafts, has now become the subject of scientific research. Bulletin No. 184, recently issued by the Council for Scientific and Industrial Research of Australia (Melbourne: Gov. Printer, 1945), describes a series of important fundamental investigations on the fellmongering process carried out by F. G. Lennox, Margaret Maxwell and W. J. Ellis.

There are, speaking very roughly, two types of sheep farmed in Australia: the Merino sheep, with long fine wool and, even at best, a poor pelt, and the crossbred sheep with shorter, coarser wool and a better pelt. There are also two general methods of de-wooling. The older process, with origins lost in antiquity, is known as 'sweating'—the sheepskins are hung in a warm moist atmosphere until the wool loosens and can be pushed off the pelt by the hand, the wool fibre coming away complete with root. The more recent process is 'painting'; the skins are covered on the flesh side with a thick cream of lime and a reducing agent, generally sodium sulphide, and the alkali plus reducing agent travel through the skin and cause the wool fibre to break off just above the root. The painting process therefore leads to a slight shortening of the fibre, and the total loss of weight from this cause is sufficient to keep the older sweating process in being for Merino sheepskins, in spite of the considerable damage frequently done to the pelt, and the foul odour of the sweating chambers.

The present pamphlet contains twelve papers describing studies on wool-loosening by the sweating process, the effect on the pelt not being included. It is interesting that the foundation of the work is the development of a quantitative method for measuring the force required to detach a standard staple from the pelt. With this tool in the hands of the investigator, it becomes possible to study, with some accuracy, the effect of varying conditions on the rate at which the wool root is loosened from its base.

The active agents in the sweating process are bacteria; an ærobe, an atypical strain of *Proteus vulgaris* designated No. 7, being the dominant wool-loosening organism, though three or four other species also have the same effect. No. 7 exists sparsely at the wool roots at the start of the sweating process, and freely when the wool is ready to pull. The agents of putrefaction which damage the pelt are anærobes. Many skins from up-country kills are dried for transport and have to be soaked back by the fellmonger before they can be sweated. Studies of this soaking operation show that the soak-water is completely de-oxygenated, a condition which encourages the growth of putrefactive anærobes. This, however, does not appear to inhibit the growth of No. 7 in the sweating chambers, and oxygenating the soak-water does not accelerate wool-loosening.

During sweating a large amount of ammonia is produced. Ammonia itself has a wool-loosening action, but the accumulation of ammonia tends to inhibit bacterial wool-loosening. The action of ammonia is due to the NH_3 molecule. Aliphatic amines have a similar effect, though this diminishes with increasing size of the molecule, quaternary ammonium compounds having little activity. Lipid solvents similarly have a wool-loosening action, while reagents causing dehydration, such as acetone and solutions of sodium chloride, and even drying, have a wool-tightening action. Conditions which cause tissue-swelling also cause tightening, probably because the hair-bulb cannot pass up the follicle.

The impression left on the reader of the twelve papers is of work well planned, well executed and well reported. An interesting development of the research is a new method of de-woolling the numerous small scraps from the edges of skins treated by the painting process, as well as shanks and head pieces. In these the scraps of pelt have no commercial value, and it has been shown that by subjecting them to heat treatment at 65° C. the skin tissues can be completely hydrolysed by proteases prepared from a bran culture of *Aspergillus flavus-oryzæ* or by papain, leaving the wool undamaged.

The volume well illustrates how even the oldest craft can be improved by an understanding of its scientific basis, and further developments will be awaited with great interest.

D. JORDAN LLOYD.

FORTHCOMING EVENTS

Saturday, October 20

Royal Institute of Chemistry, London and South-Eastern Counties Branch (at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1), at 2.30 p.m.—Discussion on "The Publicity of Science, with particular reference to Chemistry" (Dr. O. J. R. Howarth, O.B.E., Mr. O. F. Brown, Mr. G. A. Jones and others).

Institution of Mechanical Engineers, Graduates' Section (at Storey's Gate, St. James's Park, London, S.W.1), at 3.30 p.m.—Mr. R. Gore: "A System of Production Control".

Tuesday, October 23

Royal Anthropological Institute (at 21 Bedford Square, London, W.C.1), at 5 p.m.—Prof. V. Gordon Childe: "The Science of Man in the U.S.S.R."

Zoological Society of London (at Regent's Park, London, N.W.8), at 5 p.m.—Scientific Papers

Institute of Physics, Electronics Group (in the Reid-Knox Hall, British Institute of Radiology, 32 Welbeck Street, London, W.1), at 5.30 p.m.—Prof. N. F. Mott, F.R.S: "Recent Work on the Theory of the Latent Image".

Royal Photographic Society, Scientific and Technical Group (at 16 Princes Gate, South Kensington, London, S.W.7), at 6 p.m.—Mr. J. F. Dunn and Mr. G. S. Plant: "A New Photometric Exposure Meter for Camera and Enlarger".

Wednesday, October 24

Manchester Metallurgical Society (joint meeting with the Institute of Metals and the Iron and Steel Institute) (at the Engineers' Club, Albert Square, Manchester), at 6.30 p.m.—Dr. R. Jackson: "The Application of Radiography to the Improvement of Foundry Technique".

Institute of Welding, Wolverhampton Branch (at the Victoria Hotel, Wolverhampton), at 7 p.m.—Mr. H. Thompson: Chairman's Address.

Thursday, October 25

Linnean Society of London (at Burlington House, Piccadilly, London, W.1), at 5 p.m.—Prof. H. Hartridge, F.R.S.: "The Direction of Flight of Bats by means of Sound Waves"; Mr. James Hornell: "How did the Sweet Potato reach Oceania?"

Friday, October 26

Chemical Society (joint meeting with the Glasgow University Alchemists Club and the Andersonian Chemical Society) (in the Large Lecture Theatre of the Chemistry Department, The University, Glasgow), at 3.30 p.m.—Sir Robert H. Pickard, F.R.S.: "Long Chain Molecules".

Bedson Club (in the Chemistry Lecture Theatre, King's College, Newcastle-upon-Tyne), at 5.30 p.m.—Prof. N K. Adam, F.R.S: "Surface Films" (Sixtieth Bedson Lecture).

Institution of Electrical Engineers, Measurements Section (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. S. H. Richards Inaugural Address as Chairman.

Institution of Mechanical Engineers (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Prof. R. N. Arnold: "The Mechanism of Tool Vibration in the Cutting of Steel".

Chemical Society (joint meeting with the South Yorkshire Section of the Royal Institute of Chemistry) (in the Chemistry Lecture Theatre, The University, Sheffield), at 6 p.m.—Prof. D. T. A. Townend: "Flame".

British Association of Chemists, St. Helens Section (at the Y.M.C.A. Buildings, St. Helens), at 7.30 p.m.—Mr. A. Rees-Jones. "From Lab. to Full Scale Production".

Institute of Welding, East Scotland Branch (at the Heriot-Watt College, Chambers Street, Edinburgh), at 7.30 p.m.—Mr. D. M. Kerr: "Recent Advances in Welding in the Shipbuilding Industry".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned.

Assistant Veterinary Investigation Officer—The Secretary and Bursar, Seale-Hayne Agricultural College, Newton Abbot, Devon (October 26).

Head of the Building Department of the St. Helens Municipal Technical College—The Director of Education, Education Office, Cotham Street, St. Helens (October 27).

Chemist—The Secretary and General Manager, Newcastle and Gateshead Water Co, Pilgrim Street, Newcastle-upon-Tyne, 1 (October 27).

Teacher (full-time) of Physics and Mathematics in the Department of Chemistry, Physics and Biology of the Doncaster Technical College—The Chief Education Officer, Education Offices, Doncaster (October 27).

Lecturer in Mechanical Engineering Subjects (Graduate in Engineering or with equivalent qualifications and capable of teaching to Higher National Certificate standard), a Lecturer in Chemistry (well qualified academically to undertake work to Degree standard), and a Lecturer in Building Subjects (qualified to undertake work to Higher National Certificate standard), in the St. Helens Municipal Technical College—The Director of Education, Education Office, Cotham Street, St. Helens (October 27).

Civil Engineers by Singapore Municipality. Civil Engineer to become Assistant Municipal Engineer (Roads and Bridges) (Ref. No E.1978.XA), Civil Engineer to become Assistant Municipal Engineer (Sewerage) (Ref. No. E.1979.XA), and a Civil Engineer to become Assistant Water Engineer (Ref. No. E 1980.XA)—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W C.2, quoting the appropriate Ref. No. (October 29).

Graduate Lecturer (full-time) in the Department of Mechanical Engineering of the Coventry Technical College—The Director of Education, Education Department, Council House, Coventry (October 29).

Senior Temporary Assistant (man or woman) under the Psychological Adviser—The Secretary, Civil Service Commission (Dept. O), 6 Burlington Gardens, London, W.1 (October 30).

Lecturer (full-time) of Science and Mathematics in the Department of Building and Architecture of the Liverpool Technical College—The Director of Education, 14 Sir Thomas Street, Liverpool, 1 (October 31).

Instructor (full-time) in Production Engineering Subjects at the Leeds College of Technology—The Director of Education, Education Office, Leeds, 1 (November 3).

Deputy Borough Electrical Engineer—The Borough Electrica Engineer, Shannon Street, Blackpool (November 5).

City Electrical Engineer, Salisbury, Southern Rhodesia—The Ministry of Labour and National Service, Appointments Department Technical and Scientific Register, Room 670, York House, Kingsway London, W.C.2, quoting D.1485.XA (November 6).

Fellowship in Electrotechnology, Council for Scientific and Industrial Research, Melbourne—The Australian Scientific Researc Liaison Office, Australia House, Strand, London, W.C.2 (November 9).

Assistant Lecturers in Botany, Chemistry, Mathematic Physics, Zoology and Geography—The Registrar, University College, Leicester (November 10).

Technical Translator into English from Swedish by first class electrical engineering company in Sweden, primarily for the English edition of their technical house journal—The Ministry of Labour and National Service, Appointments Department, Technica and Scientific Register, Room 670, York House, Kingsway, London W.C.2, quoting D.1498 XA (November 12).

Director—The Chairman of the Council, British Electrical an Allied Industries Research Association, 15 Savoy Street, London W.C.2 (November 16).

Lecturer in Industrial Chemistry, a Lecturer in Mechanica Engineering, and an Assistant Lecturer in Chemistry, at the University of Queensland—The Agent-General for Queensland, 40 Strand, London, W.C.2, and the Secretary, Universities Bureau o the British Empire, c/o University College, Gower Street, London, W.C.1 (November 30 in Brisbane)

Deputy Engineer and Manager of the Warrington Corporatio Water Works—The Town Clerk, Town Hall, Warrington, endorse 'Deputy Water Engineer and Manager' (November 30).

Director of Museums, Liverpool—The Town Clerk, Municipa Buildings, Dale Street, Liverpool, 2, endorsed 'Director of Museums (November 30).

Sorby Research Fellowship—The Assistant Secretary, Roya Society, Burlington House, Piccadilly, London, W.1 (December 1).

Tucker-Price Scientific Research Fellowship for research o Mathematics, Natural Sciences and allied subjects—The Secretary Girton College, Cambridge (January 15).

Instrument Makers (20) for the Telecommunications Researc Establishment, Malvern—The Exchange Manager, Ministry of Labou and National Service, Malvern.

Pathologist (whole-time)—The Superintendent, Northampto General Hospital, Northampton.

Demonstrator in the Department of Physics, and a Junio Demonstrator in the Department of Biology—The Secretary St. Mary's Hospital Medical School, Paddington, London, W.2.

Laboratory Steward for cancer research laboratory, to tak charge of animal house—The Director of Research, Glasgow Roya Cancer Hospital, 132 Hill Street, Glasgow, C.3.

Technical Librarian—The Secretary, Copper Developmen Association, Grand Buildings, Trafalgar Square, London, W.C.2.

Lecturer in Neuropathology in the University of Sydney an Neuropathologist to the Mental Hospitals of New South Wales—The Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1.

Crop Recorder at the Institute's Sub-station in Hampshir (applicants should have had a sound training in agriculture and/o botany)—The Secretary, National Institute of Agricultural Botan Huntingdon Road, Cambridge.

Teacher (part-time) of Geography—The Principal, West Ham Municipal College, Romford Road, Stratford, London, E.15.

Assistant in the Department of Chemistry—The Secretary, The University, Aberdeen.

Lecturer (full-time) in Electrical Engineering (capable teaching Design of Electrical Machinery up to the Higher Nationa and London University Final B.Sc. Degree standard, together wit at least one other advanced electrical subject)—The Principal, Roy Technical College, Salford, 5.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

H. M. Treasury. Statements relating to the Atomic Bomb. Pp. 24 (London: H.M. Stationery Office, 1945.) 4*d.* net. [28

Ministry of Education. Pamphlet No. 2: A Guide to the Educational System of England and Wales. Pp. 64. (London: H.M Stationery Office, 1945.) 1*s.* net. [28

Post-War European Broadcasting. A Report prepared by the British Radio Equipment Manufacturers' Association. Pp. 2 (London: Radio Industry Council, 1945.) [29

NATURE

No. 3965 SATURDAY, OCTOBER 27, 1945 Vol. 156

CONTENTS

Page
Care of Geological Features in England and Wales . 485
Plant Life and Solar Energy. By Prof. F. J. Lewis . 487
Medicine and the Humanities. By Dr. G. Lapage . 488
Acoustic Control in the Flight of Bats. By Prof. H. Hartridge, F.R.S. 490
The Concept of Mental Maturity. By Prof. A. W. Wolters 494
Science in Kweichow and Kuangsi. By Dr. Joseph Needham, F.R.S. 496
Obituaries :
  Sir David Milne-Watson, Bt. By Dr. E. F. Armstrong, F.R.S. 499
  Dr. A. Lees. By Prof. H. T. H. Piaggio . . 499
News and Views 500
Letters to the Editors :
  Electrical Resistance of Liquid Metals.—Prof. K. S. Krishnan, F.R.S., and A. B. Bhatia 503
  Stability of the Earth's Atmospheric Oxygen.—Alfred Lauck Parson 504
  Thermal Decomposition of $HgCl_2$ Vapour.—Dr. K. Wieland 504
  Loss of Antimalarial Properties in Quinine Degradation Products.—P. B. Marshall 505
  A Convenient 'Bridge' for Two-Solution Cells.—Dr. S. M. Neale 506
  Chromium Oxide as a Promoter in Catalysts for the Fischer-Tropsch Synthesis.—Sir J. C. Ghosh and S. L. Sastry 506
  Darkened Violet in Colour Vision.—Dr. R. W. Pickford 506
  Crystalline Hæmolytic Substance from Normal Blood.—Dr. H. Laser and Dr. E. Friedmann . 507
  Respiration of Spermatozoa in Egg-Yolk Medium.—J Tošić and Dr. Arthur Walton 507
  Thiourea and the Suprarenal Cortex.—Dr. Gertrude E. Glock 508
  Palolo Worms.—Prof. Hubert Lyman Clark . 508
Research and Development in the British Colonies . 509
Indian Fishes and Fisheries 511
Chemistry in China 511
Recent Scientific and Technical Books . . . Supp. ii

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CARE OF GEOLOGICAL FEATURES IN ENGLAND AND WALES

BRITAIN occupies a peculiarly vital position in geological science. Within its small area are examples of a great range of geological features and of rocks of almost all ages. In the development of geology, British investigators have played an exceedingly important part and have laid the foundations of many branches of study. Many parts of Britain, therefore, contain features of considerable historic interest which will long continue to be of importance to students. In general, it may seem unnecessary to give much attention to the preservation of such geological features, for in many cases they have survived for centuries, and it is not likely that future development will cause them serious harm. The case for their preservation does not always appear to be so urgent as that for the preservation of plants and animals, rare species of which may be exterminated as a result of changes in the utilization of the land. It is desirable, however, at this time, when greater attention is being devoted to the planning of the countryside, that the need for some consideration of geological monuments and sections should not be overlooked, especially as some of the sections are of importance in the progressive development of the science. It is also most essential that arrangements should be made to secure free access to these sites.

These questions have recently been considered in some detail by a Geological Sub-Committee set up by the Nature Reserves Investigation Committee and presided over by Dr. G. F. Herbert Smith. Members of the Sub-Committee included representatives of the Geological Society of London and of the Geological Survey. They have been assisted by more than forty geologists with local knowledge. The report of this Sub-Committee has just been issued*, and it may be hoped that its recommendations will be carefully considered by those concerned with the planning of national parks and nature reserves under the Minister of Town and Country Planning.

The appointment of this special Sub-Committee indicates a recognition that the preservation of geological sections requires different measures from those necessary for the protection of wild life, and the Sub-Committee has worked out its own classification of the types of area and site to which consideration needs to be given. They have defined four separate categories as follows :

(*a*) *Conservation Areas* (*Geological*). Large-scale physiographic features and areas containing many items of geological interest. Working quarries in such areas are to be registered, new quarrying or other works to be undertaken only after approval has been obtained from the appointed authority, advised by a scientific panel.

(*b*) *Geological Monuments.* Small-scale geological features and sections of outstanding interest, to be permanently protected and kept in a good state of preservation.

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* Report by the Geological Sub-Committee of the Nature Reserves Investigation Committee. Memorandum No. 5 : National Geological Reserves in England and Wales Pp iv+42. (Society for the Promotion of Nature Reserves, British Museum (Natural History), London, S.W.7.) 1*s*. 6*d*.

(c) *Controlled Sections.* Natural sections and artificial sections in a state of disuse, to be subject to control on account of their scientific value, in order to protect them from being obscured by building or the dumping of refuse, or otherwise rendered inaccessible.

(d) *Registered Sections.* Sections of exceptional geological importance at present used or worked, to be listed and to be kept under observation by an appointed authority, the owners or lessees being required to give notice of their intention to cease operations, in which event the sections in question would be considered for transference to the previous category, (c).

In these four categories the Sub-Committee has listed 390 sites in England and Wales, arranging them under counties for convenience of reference; 331 of these sites are in England, 58 in Wales and one is shared by both countries. Of conservation areas there are 71, of geological monuments 48, of controlled sections 198, and of registered sections 73. These are large numbers; but when the lists of sections given under any county are examined, it is at once recognized that there has been rigorous selection of those sections which are recommended for control or registration, and an even more careful scrutiny has been given to the selection of geological monuments. Many quarries of great scientific importance are not listed. Moreover, the controlled sections include many stretches of sea cliffs which are not likely to be greatly affected by any changes which can be foreseen, but to which it is essential that access should continue to be available; conservation in these cases will not be costly or difficult.

The sites selected are very unevenly distributed over England and Wales, as is to be expected. They fall chiefly in areas where there are harder rocks, for these yield features which may be scenically more attractive and which are more likely to be permanent. It is doubtful, as the Sub-Committee notes, whether much can be gained by preserving a clay pit after its working has ceased. There is thus only one section indicated in Essex and only two in Hampshire, while there are twenty-six in Shropshire and forty-two in Yorkshire. It is a little surprising, however, to find only two each in Cardiganshire and Carmarthenshire. It may be hoped that some sections in the classic areas of Llandeilo and Llandovery in the latter county may be found suitable for conservation.

When the large number of the suggested areas is being considered, several points must be borne in mind. In the first place, many will probably fall within areas which will be utilized as national parks. It may be hoped, therefore, that it will be easier to effect some measure of control. Others will probably overlap with conservation areas chosen on biological grounds, and obviously much is to be gained where the purposes of both biology and geology can be served by the conservation of single areas. Moreover, many of the sites suggested as monuments and as controlled and registered sections fall within the wider conservation areas.

There is clearly a distinction between the problems of registration and control of sections and monuments and the provision of access to them on one hand, and the conservation of large-scale features containing many items of geological interest on the other. In the case of monuments and sections, little supervision is necessary; and provided that access can be secured, little more than periodical inspection is required. It is to be hoped that in such cases a descriptive label (the Sub-Committee suggests in the form of a metal plate) would be set up. There is little doubt that this would have great educational value. Many of the geological monuments listed, such as the Bowder Stone in Borrowdale and Durdle Door, west of Lulworth Cove, are already visited by great numbers of walkers and others. An indication of their significance and of the fact that they are of national interest would do much to stimulate a greater attention to geological phenomena.

The conservation areas suggested by the Geological Sub-Committee involve tracts of country, some of them very small, others covering considerable areas. They include such features as Incombe Hole, Ivinghoe, Bucks, the Lizard Peninsula, four tracts in Derbyshire and six coastal regions in Dorset. It is rather surprising to find that no areas are specified in Cumberland, though it is possibly anticipated that the Lake District will be covered by a proposed national park. Some of the areas included are of physiographical as well as geological interest; and it would be valuable to consider the addition of other physiographic types, such as some areas in the Norfolk Broads or the Fens, and other coastal features such as Chesil Bank, which is conveniently near an area already specified as a controlled section.

The Sub-Committee holds the view that such geological conservation areas should be kept, so far as possible, in their present condition. They do not suggest that quarrying and other industrial activities should cease, for they recognize that the geologist gains greatly from the working of quarries. It is indeed obvious that in many cases more may be gained by continued working of a quarry than by the preservation of a particular section in its present condition. On the other hand, it may be possible to secure the preservation of a column representative of an important section revealed in the course of quarrying operations.

The Sub-Committee indicates that the list which it has provided is not to be regarded as final; and it is engaged in the preparation of a second list of sites and sections of less general interest, some of which it suggests might be preserved by local action. It is desirable that local patriotism should be roused for the protection of many of these features, and that their educational value should be made more widely known.

The conservation of these sites is not only of educational value, however. While it may be hoped that the control of monuments and sections would direct the attention of a wider public to the existence and terest of most of these features, it must be emhasized also that many of them are of vital importce for scientific research. Moreover, it may be ped that the conservation of these features will ing enjoyment and stimulus to many who are terested in the countryside but who have no special owledge of geology. One valuable aspect of the nservation of such features is that it involves no strictions on the general public. Whereas it may necessary in the case of some nature reserves to mit access, in the case of geological reserves all that required in most cases is to secure that access mains available for geologists as well as for other sitors. The protection of many of these features ould thus increase and safeguard the general nenities of the countryside for the public as a hole.

It will be noted that the present report refers to ngland and Wales only. Similar questions are being alt with separately in relation to Scotland, where may be hoped that comparable steps will be ntemplated.

LANT LIFE AND SOLAR ENERGY

hotosynthesis and Related Processes

y Eugene I. Rabinowitch. Vol. 1: Chemistry of hotosynthesis, Chemosynthesis and related Prosses in Vitro and in Vivo. Pp. xiv+599. (New ork: Interscience Publishers, Inc., 1945.) 8.50 ollars.

THIS book is an outstanding contribution to the problem of photosynthesis, and is the first volume a work which will deal with this fundamental hysiological process from the chemical, physical and otanical points of view. The author is a research sociate, Solar Energy Conversion Research Project, assachusetts Institute of Technology, and explains at while this work is not concerned directly with hotosynthesis "it has helped to keep alive an interest the subject, for while experimenting on the conrsion of light energy into chemical energy one nnot but turn continuously to plants and wonder w Nature has achieved a result which has not been proached in the laboratory".

This volume is divided into two parts, the first aling with the chemistry of photosynthesis and lated processes, and a second part dealing with e structure and chemistry of the photosynthetic paratus. These are preceded by two introductory apters, one concerned with the role of photonthesis in Nature and the second with the discovery photosynthesis. Both these chapters might be ad with great interest by the general reader. It is range that although this process is so fundamental the existence of all life it was not discovered until e eighteenth century. Since then investigations ve increased at a great rate in all countries, and the present time the literature on this subject in ientific journals is immense. It is contained in otanical, chemical, physical, agricultural and physiogical journals, so that the preparation of a complete bliography is a formidable task. Dr. Rabinowitch s gone far in achieving this, and every part of e present volume is well documented and every apter contains a bibliography; the one following chapter 10, for example, quoting more than 250 references from 1843 until 1940. The great amount of literature brought together and discussed makes this work of great interest both to chemists and to physicists.

Each of the two parts of the present volume is divided into a number of chapters dealing with different phases of the subject. The first part is subdivided into ten chapters and each into many sub-sections. Dr. Rabinowitch first treats of the over-all reaction and the products of photosynthesis and then goes on to consider related processes outside the living cell. Then follow chapters dealing with the photosynthesis and chemosynthesis of bacteria and the metabolism of anærobic bacteria, with a significant section on the role of autotrophic bacteria in Nature. "Green plants reduce carbon dioxide in light by means of water; green and purple sulfur bacteria reduce carbon dioxide also in light by means of hydrogen sulphide; colourless sulfur bacteria reduce carbon dioxide by means of hydrogen sulphide without light. This comparison shows the existence of a hierarchy of autotrophic organisms and encourages speculations as to the genetic relationships between them." This leads on to a discussion of the primary photochemical process of the oxidation of water as the first stage and the reduction of carbon dioxide as the primary process. In a subsequent chapter we have a discussion on the assumption that the reduction of the complex carbon dioxide is a non-photochemical process involving an intermediate reductant and not a photochemical reaction with reduced or excited chlorophyll. Later chapters deal with inhibition of photosynthesis by chemical and physical agents.

In Part 2, which is concerned with the structure and chemistry of the photosynthetic apparatus, one of the most interesting chapters deals with the structure, composition and pigments of the chloroplasts and chromoplasts. The revival of the hypothesis of chlorophyll grana in 1932 and its confirmation by photographs by Doutreligue in 1936 is described. This confirmation showed that the grana are distributed more or less uniformly throughout the chloroplast in distinction to the earlier views that they were concentrated on the surface. Later chapters deal with the chlorophylls *a* and *b* and their ratio; the chlorophylls of the algæ and the concentration of chlorophylls in leaves. The molecular structure and chemical properties of chlorophyll form an important section and the latter part of Part 2 is devoted to the accessory pigments such as the carotinoids, phycobilins, flavones and anthocyanins. Then follow chapters on the photochemistry of pigments *in vitro* and *in vivo* and the last chapter discusses photosynthesis and respiration.

Dr. Rabinowitch raises the question of a possible connexion between the two catalytic mechanisms, and observes that while the nature of the links is as yet quite uncertain they will undoubtedly be subject to closer study in the near future. He follows this up by quoting observations on the effect of light on respiration and observes that "none of the experiments described provides a final proof of the non-existence of true 'photorespiration', the least that can be stated is that no evidence of such a phenomenon has as yet been found (except perhaps in ultra-violet light), and that all definitely established cases of light stimulated respiration were of the 'persistent' type, and could be attributed either to an accumulation of sugars or to an indirect photochemical effect of blue-violet light absorbed by the carotenoids".

This book differs from previous works on the subject by the greater emphasis on physical and physico-chemical theories and methods due to the newer trends in the study of photosynthesis. Photosynthesis in relation to systematic botany or ecology has little place in it. It is essentially written for the research worker and should greatly stimulate work along these lines. The important literature from all sources is brought together and discussed and the book thus forms a very notable addition to the literature in this field. The appearance of Vol. 2 will be awaited with interest.

F. J. LEWIS.

MEDICINE AND THE HUMANITIES

The Art of Medicine in Relation to the Progress of Thought

A Lecture in the History of Science Course in the University of Cambridge, February 10th, 1945. By A. E. Clark-Kennedy. Pp. 48. (Cambridge: At the University Press, 1945.) 2*s.* net.

THIS lecture, written in simple words and infused by a contemplative charm, is not designed to answer the age-old questions: Have we a soul? What is mind? and so forth. It briefly discusses these questions and suggests to us why they cannot be answered and why they probably never will be answered. But the purpose of the lecture is rather to consider how medicine, by bringing science and thought into intimate and personal relationship with humanity, "has resulted in science making a greater contribution to thought than otherwise would have been the case".

In his brief history of the development of medicine and his longer one of the developments of the last hundred years, the author gives, in a short space, a valuable dissertation on his general theme. Prominent in it is the new conception of disease which has arisen, a conception which is an advance upon Sydenham's useful conception of clinical entities, which has, the author thinks, tended to obscure the real nature of disease and to lead to a superficial attitude to problems of medical practice. In a similar way, it might be added, too much emphasis in all fields of inquiry on useful and, indeed, necessary, classification can have a similar effect. The medical man, however, is faced with problems of the mind as well as with those of the body. The body, says the author, has evolved as a physico-chemical machine. Within certain limits it influences and is influenced by the mind. To this the medical man must add the influences of genetic and environmental factors upon the production of disease; and consciousness, as distinguished by the author from the more general and unsatisfactory term 'mind', brings problems of pain, of deliberate thought and free-will and of moral and æsthetic judgment. Man is learning rapidly how to gain health, but is free, as the practising physician knows so well, to make himself as well or ill as he wills. The difficult problems for the medical practitioner which result from this and the repercussions of this view of disease upon politics, social planning, preventive medicine and State control occupy the bulk of this lecture.

On the whole, the author successfully sketches, in the brief space available to him, the main complexities of the modern medical outlook. Only here and there will the reader sit up and blink a little—as, for example, when he reads that, since the studies o Vesalius, Harvey and Malpighi, biology "has limpe along behind the mechanical sciences in the part worn clothes of her elder sister, physics". The autho seems to be quite unaware that biology has recentl undergone a change not dissimilar from that whic he indicates in medicine. The causes, indeed, o the changes in these two related fields of inquir are, and perhaps must be, essentially the same Many readers will, however, no doubt agree that th psychologists, even those who labour so earnestl and passionately to heal the disordered mind, hav nothing to guide them but an imperfect understandin of the normal mind. It sometimes seems, indee that the sick minds studied by the medical psychologist have within them a capacity for self-destructio and for the destruction of society which is analogou to that contained by the unstable isotope of uraniu used to make the atomic bomb. But does the psychologist know the stable isotope? If he does *not*, upo what does he base the theories of human educatio and conduct which are put forward for the directio of our youth and our society? The medical psychologist can, of course, not be blamed for this lack o knowledge of the norm; he is straining every nerv all the time to construct it. The only prematur thing is that our future should be subject to an form of directive whatever which is still immatur and uncertain of its foundations.

To return, however, to the main theme of thi book, its main conclusions are that there is too muc specialization in medical education (a point which i already widely recognized), and that the purely scientific education which medical students now receive is not enough for a profession which has to deal with human life and experience as a whole. I is half the art of medicine, says the author, to adop a reasonable and practical attitude to the unknown The power of modern medicine to prolong life, to relieve suffering, to influence endocrine secretion, to control birth, to dominate mind and even to modif personality is likely to increase; it should not b diminished; but in it there is a real danger. "There always is danger in power."

We live in an age when excessive anxiety ove the health of the body has replaced pre-occupatio with the welfare of the soul. Many problems, nov decided upon ethical grounds, will, in the future, b decided entirely upon grounds of medical expedienc and judgment. To meet this situation medicin could and should, the author thinks, be the connecting link which would reconcile the conflicting point of view of the humanities, on one hand, and th sciences on the other. Disease is not entirely geneti or environmental in origin; behaviour is not a conditioned reflexes and is not entirely due to deliberate thinking. There is a happy mean betwee too much individual liberty and too little externa control; too great risk and too little security; to much pain and too little suffering. Medicine has no yet displaced the notion of the soul, and probabl it never will. It is not irrelevant to remember tha it is one of the privileges of medicine to handle th biological phenomenon of death, "and here we com into closest touch with the spiritual aspects o human life".

There should be few scientific readers who wi not, if they look sincerely into their experienc endorse and welcome the main argument of th thoughtful and thought-provoking book.

G. LAPAGE.

Vegetable and Fruit Growers' Conferences

Edited by Dr. D. H. Robinson. Pp. 64. (Worcester: Littlebury and Co., Ltd., 1945.) 6*s*. net.

THIS little book consists of fourteen short papers read to the Vegetable and Fruit Growers' Conferences held in Worcester in December 1944. The ontributors are prominent commercial growers and members of research station and Ministry of Agriulture staffs.

The first paper, by Dr. H. V. Taylor, gives an account of the expansion of vegetable production during the War and probable future requirements. The second, by G. H. Tawell, deals with artificial irrigation of vegetable crops and gives useful guidance on methods, and the application of fertilizers in olution. Prof. T. Wallace contributes the next three pages on the factors determining soil fertility, and a single page by Prof. G. E. Blackman deals with the chemical control of weeds. D. R. Bomford makes a convincing plea for research on horticultural as distinct from agricultural machinery, and suggests specifications of various implements. J. F. Bomford calls for a compulsory marketing and distribution scheme and the education of urban populations in the importance of the industry and its problems. The next four papers, by N. H. Grubb, J. Turnbull, C. P. Norbury and F. J. Masters respectively, give the merits and defects of the main commercial varieties of soft and tree fruits. V. L. S. Charley discusses varieties of apples and pears for cider and perry making and of soft fruits for syrup production. G. A. Nott makes out a case for the production of unfermented apple juice as a means of disposing of low-grade fruit. D. A. Osmond writes on the soil series to be found in Worcestershire and their suitability for various crops, and the book ends with an account by W. L. Moore of his experiences in planting a cherry orchard under grass.

The papers provide stimulating thumb-nail sketches of subjects of current importance to commercial growers, and those on fruit varieties should be particularly useful. There are a few minor typographical errors.

W. E. B.

Time, Number and the Atom

By R. Fortescue Pickard. Pp. vii+92 (London: Williams and Norgate, Ltd., 1945.) 8*s*. 6*d*. net.

MR. PICKARD is interested in numbers, particularly primes and perfect squares. He points out that the ratio of the masses of the proton and the electron may be taken as 1849, and this is the sum of the consecutive primes from 3 to 131 inclusive; or as Mr. Pickard prefers to put it, the mass of the whole hydrogen atom is 1850, which is the sum of the first 32 primes, 2 being omitted. In an appendix he gives arguments in favour of omitting 2 from the list of primes. He also points out that $1849 = 43^2$, and 43 is the sum of the terms in the bracket when the Rydberg Series is taken as far as corresponds to the completed series of the Periodic System.

A search for further arithmetical relationships leads him to regard each element as characterized by two integers, its atomic number and its mass number. On account of the existence of isotopes it becomes necessary to choose a "primary" mass number, which is often the rounded atomic weight, or the mass number of the most abundant isotope, but may be that of a rarer isotope, or even of an isotope as yet undiscovered: for example, $\mathrm{Li} = 6$, $\mathrm{B} = 10$, $\mathrm{Sc} = 44$. From this array of numbers Mr. Pickard produces some interesting patterns, though as these mostly involve the sums of the mass numbers of groups of consecutive or otherwise related elements, it is difficult to see what physical significance they can have.

The word "time" in the title refers to certain metaphysical arguments tending to identify the fundamental ideas of time and number.

F. J. GARRICK.

Astronomical Air Navigation

A Comprehensive Handbook embodying the Latest Principles for Practical Navigators, Instructors and Students. By Squadron-Leader Ronald Hadingham. Second edition, revised and enlarged. Pp. xii+152. (Kingston Hill: Technical Press, Ltd., 1945.) 12*s*. net.

THE second edition of Squadron-Leader Hadingham's handbook on astronomical air navigation has been enlarged and revised. A description is included of the Mark IXA bubble sextant, with which the navigator continues his observation for two minutes, during which period the altitude is recorded sixty times and the average value of the observed altitude is automatically indicated; the accuracy of observation during unsteady conditions of flight is thereby considerably increased. A full description is also given of the astrograph and its uses; with this instrument, which was for long on the secret list, the position lines for different altitudes of two stars suitably placed for observation are projected on to the navigator's chart, enabling the position of the aircraft to be obtained quickly and without computation. The chapter dealing with star identification has been enlarged.

The volume is a useful and essentially practical handbook. It is somewhat marred by a number of loose statements, such as that "the value of refraction is always negative and must be subtracted from the observed altitude", and that "this gradual change (i.e. precession) must also produce a change in the positions of the seasons". The statement, on p. 83, that the earth's axis is inclined at 23½° to the plane of its orbit is so obviously incorrect that it is not likely to be misleading.

The Annual Register

A Review of Public Events at Home and Abroad for the Year 1944. Edited by Dr. M. Epstein. Pp. xii+506. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1945.) 42*s*. net.

WITH unfailing regularity, unbroken since 1758, this volume presents a year of the history of the world and a survey of progress in art, literature, science and finance. The usual arrangement is maintained, beginning with a summary of English political history and the course of the War, followed by imperial history; and then the most important movements and events in foreign history, which reveal much that may have been lost sight of in the limited space of current newspapers. The second part includes a chronicle of events, obituaries of the year and retrospects of various aspects of national life. Public documents printed in full include the Bretton Wood agreements, the Franco-Soviet treaty and the Dumbarton Oaks proposals. An excellent index facilitates the use of the volume. No student of current affairs can afford to dispense with this full and objective survey of the world's history.

ACOUSTIC CONTROL IN THE FLIGHT OF BATS

By Prof. H. HARTRIDGE, F.R.S.
St. Bartholomew's Hospital Medical College

NO one interested in wild life or in the science of flight can fail to be curious about bats, which in skill of manœuvre and fearlessness excite our admiration. The facts that their flight is as technically perfect in complete darkness as it is in daylight, that their wings are entirely different in design from those of the birds, and that, unlike most living creatures, they sleep hanging head downwards, add greatly to our interest in them. Small wonder if to the superstitious or the ignorant of bygone days they appeared to be guided, controlled and protected by the Prince of Darkness himself.

The hypothesis which I advanced in 1920[1] to explain their adjustment of speed and direction when flying at night was "that bats during flight emit a short wave-length note and that this sound is reflected from objects in the vicinity. The reflected sound gives the bat information concerning its surroundings. It is possible that if a bat makes use of short-wave-length sound it would be able to estimate the position in space of an object ahead of it with considerable accuracy". There seems to be little room for doubt that this hypothesis is correct, for Galambos and Griffin[2,3] found that bats while in flight emit a discontinuous supersonic note. They can steer clear of obstacles, even thin carpet thread (Hartridge), or thin wire (Hahn[4]), when flying in complete darkness provided they can emit this note and receive its reflexion from surrounding objects by their ears. If, however, they are made mute or deaf they run into such obstacles.

It is the object of this communication to try to elucidate the details of this localizing mechanism, for there are a number of disconnected observations concerning it which can now be fitted into position.

Sounds Produced by Bats

If a physicist were asked to design the vocal apparatus for a bat he would, I think, decide that this should be capable of producing two different kinds of sound: one for the purpose of avoiding obstacles while in flight; the other for sending messages to neighbouring bats, because, as will be seen shortly, no single sound would be suitable for both these purposes.

For localization, an interrupted supersonic tone is required with short wave-length and constant intensity. The interruptions should be made in such a way that the change from emission to silence and vice versa is as sharp as possible. The number of interruptions per second should be variable so as to secure the optimum conditions for localization.

For signalling, on the contrary, a supersonic tone would be quite unsuitable, for a signalling tone should not cast sharp shadows, should be as non-directional as possible, and should have very good carrying power. If possible, it should be capable of alteration in pitch, intensity and quality, for these variations would be useful when one bat wants to inform other bats about such things as the discovery of food or the approach of danger. For such a purpose a tone of medium pitch is indicated.

The bat's vocal apparatus should then be capable of producing these two different kinds of tone, and both would fall with advantage within the range frequencies for which the bat's cochlea is mo sensitive. In man this range is not very large, for extends over only about four octaves of the whol audible gamut of about 10½ octaves. Assumin that the bat's cochlea, which is histologically ver similar to that of the human cochlea, is not ver different in performance, then the localizing frequenc and the signalling frequency should not be separate by more than about four octaves, that is, the rat between them should not exceed 16 to 1. In fac the frequency of the localizing tone in bats is betwee 45,000 and 60,000 cycles per second and that of th signalling tone is roughly 7,000 cycles per second, s that their ratio is about 7 or 8 to 1—probably we within the efficient range of the bat's cochlea. If th is so, the overtones of the signalling tone would b well heard by the bat, for its first four harmonic would fall within the optimum range of bats' hearin Other important points are that the production either localizing or signalling tone, or in emergencie both at the same time, should not interfere at a with flight. Neither should the production of th localizing tone interfere with the collection of foo since a bat's flight is largely, if not predominantl used for that function. Lastly, the localizing ton should be capable of continuous production, not, fo example, having to be stopped during the inspiratio of fresh air into the lungs.

Bats produce four different kinds of sound: (1) buzz. This is not audible unless the observer is quit close to the animal. (2) The signalling tone of abou 7,000 cycles per second. This usually lasts for quarter of a second, and may be repeated over an over again. (3) The supersonic tone. This is seldo less than 30,000 cycles or more than 70,000 cycle per second in the majority of bats. It usually lie between 40,000 and 55,000 cycles. This sound ma be emitted both when at rest and in flight. It ma be emitted once only, as a single pulse, when it last for about 0·01 sec.; or a number of such pulses ma be produced. At rest a bat may produce five to te supersonic cries per second. When it begins to fly the rate is increased to twenty or thirty per second When, however, obstacles lie immediately ahead, th number may be raised still further, to as many a sixty per second for short periods. (4) A click whic is usually audible anywhere in a small room.

Both the buzz and the click are accompanied b the supersonic tone described above. In the case o the click, there is a single short output of supersoni energy. In the case of the buzz there is a continuou evolution of the interrupted supersonic tone. I should be noted that whereas the click and buzz ar always accompanied by supersonics, the signallin tone may either be produced by itself or be accompanied by the supersonic tone.

Structure of the Throat of Bats

The structures in the bat by which the four differen types of sounds are probably produced will now b considered. The production of these sounds mus not interfere with either breathing or flying. Neithe must they make the catching of food difficult, fo this is one of the objects of bats' flight. The utilizatio of energy by the vocal apparatus must be inconsiderable, and the air passages to the lungs must no be obstructed. In addition, it would be advantageou if the vocal apparatus were small in size and ligh in weight. In all these respects it would be difficult to select a more compact and versatile mechanism than one on the plan of the mammalian larynx. In man this usually has a range of about two and a half octaves, but may extend to nearly three and a half octaves. Now, apart from the click, the three sounds produced by the bat have frequencies of 12–60 for the buzz; about 7,000 cycles per second for the signalling tone; and about 50,000 cycles per second for the supersonic tone. So different are these frequencies that it seems most unlikely that they could all be produced by the vibration of a single vocal mechanism adjusted to different tensions, masses and lengths. That two mechanisms at least are involved is probable from the fact that the buzz and the supersonic tone occur at the same time. If they were both made by the same structure, it would be necessary for the supersonic vibrations to be quenched either by greatly increasing the tension in this structure, or by allowing it to become quite slack, or by forcing its vibrating parts into contact. Each of these changes would cause an alteration in pitch to occur just prior to the beginning of the silence, and again at its cessation. But no such changes are shown in the records obtained by Galambos and Griffin. We are therefore led to the conclusion that the buzz and the supersonic tone are produced by different structures.

It is much more difficult to reach a decision with regard to the origins of supersonic and signalling tones. Since their frequencies are in the ratio of about 7 to 1, that is, within three octaves of one another, they could without difficulty be produced, one at a time, by the same vibrating structure. Some bats have been observed to produce both these tones at the same time; and it is stated that certain species of bat have two separate vibrating structures in their larynx. If these observations are confirmed, it is possible that one of these structures produces the signalling tone and the other the supersonic tone.

The position may be summarized as follows: The larynx of the bat contains at least two and possibly three vibrating structures. If two only, then one is used for the buzz, the other for both the supersonic and the signalling tones. If there are three, then the buzz and these two tones may be separately produced.

With regard to the position of these structures in relation to one another, they might be arranged either in series or in parallel. But since the buzz is used to modulate the supersonic tone, the series arrangement seems to be preferable. The air from the lungs will therefore pass through the first mechanism and then through the second, setting both of them into vibration.

The laryngeal mechanism for producing either the signalling tone or the supersonic tone might be similar to that of the normal mammalian larynx, except that for the latter greater tensions must be associated with vibrating members of small length and mass, attached at either end to exceptionally rigid supports. This conclusion fits in with the anatomical observations of Robin[5] and Elias[6] on the bat's larynx. They point out that in many places bone has replaced the more usual cartilage. They also emphasize the massiveness of the muscle bellies which set up the tension in the vocal cords. There seems to be little room for doubt that the bat's larynx is generally similar in design to the human larynx, and that it has the same mode of operation, but that it has been greatly modified in detail in order to produce the very high frequency tones required by the bat for its special purposes.

The laryngeal mechanism for producing the buzz may be constructed on similar lines to the above, but its low frequency (12–60 cycles per second) makes an alternative method possible, namely, a rhythmic opening and closing of the orifice, through which the air stream is passing, by direct muscle action.

There is one obvious difficulty in accepting such a suggestion, namely, that mammalian muscles do not as a rule contract rhythmically at such a very high rate as sixty times per second. Thus Ching and I[7] found when flexing and extending the right forearm that eleven up and down movements could be made per second. Fenn[14] obtained values of six to ten movements per second.

It may be pointed out, however, that the wings of insects are moved at very high rates by muscles histologically similar to human striated muscle, the rates of vibration in some cases being hundreds per second. It is therefore possible that certain muscles in a bat may also have a high rate, up to 60 vibrations per second.

If this is the case, it makes possible a linking of two muscle actions, one quenching the supersonic tone, the other rendering the ear insensitive to supersonic sound. This most desirable arrangement will be discussed later.

With regard to the actual structures which produce the buzz, one possible suggestion is the false vocal cords. These are situated in an anterior position to the true cords and are under the control of the will. Normally they are separated; but they are brought together during swallowing and also when the breath is being held for some violent muscular movement. They are first brought together and then separated for coughing. They might be modified for the production of the buzz by an increase in the rapidity of opening and closing under muscle action. The fourth type of sound made by a bat—the click—may be produced by the same structures, namely, by bringing them together, raising the air pressure in the lungs, separating them suddenly (during this phase the supersonic tone is produced), closing them again, reducing the air pressure in the lungs to its normal value and then separating them once more.

The Supersonic Tone

If a supersonic tone were being selected for purposes of localization, there are two physical factors which would have to be taken into account: the attenuation of sound during transmission through the air, and the resolving power that is required. As with optical instruments, so with devices using sound waves for purposes of localization, the shorter the wave-length the finer the structure the presence of which can be identified. In order to detect the presence of thin wires or threads, wave-lengths approaching the diameters of the wires would be required, the shorter the better. The use of sound of very short wave-length may lead, on the other hand, to much less effective results, owing to the attenuation of sound during its transmission through the air.

The volume of sound reflected back from a small obstacle at first improves with decrease in wave-length, but as attenuation comes into play the improvement ceases and is replaced by a falling off of efficiency.

The resolving power, other things being equal, increases in proportion to frequency, whereas the attenuation increases as the square of the frequency. The following values show how important the effect of attenuation is: at 200 cycles the distance at which the original intensity is reduced to 36·8 per cent is 1,000,000 metres; at 10,000 cycles the distance is

410 metres; but at 100,000 cycles the distance is only 4 metres. If, therefore, a bat emitted a note of the latter frequency, only 36·8 per cent of the sound intensity would reach 4 metres, and only 13·5 per cent would be present at 8 metres. Thus a bat 4 metres from an object would receive back from that object only 13·5 per cent of the sound which it emitted, assuming that the whole of the sound emitted reached the object and all of it was reflected back again into the bat's ears. Such, of course, is not the case; for in the first place there is a loss due to the radiation of the sound waves from the source, and in the second place there are the losses which occur when the sound is reflected. The smaller the object, the greater the latter losses become. With reduction of wave-length (increases of frequency) the losses by reflexion become less, but the losses by attenuation become greater. The case is not very different from that of the microscope, in which the shorter the wave-length of the light the greater is the resolving power; violet rays giving greater resolution than blue rays, and ultra-violet rays greater than violet ones. A limit is, however, soon reached owing to the attenuation of the rays by the optical media of which the lenses of the instrument are constructed. If all the facts concerning the vocal apparatus, the behaviour of the sound waves, and their reception by the ears of the bat were known, it is not unlikely that it would be found that a frequency of about 50,000 cycles per second would give an optimum effect.

Having discussed some of the physical limitations of the use of sound for purposes of localization, we may now consider the successes and failures of the method in practice. It enables the bat to steer clear of carpet thread[1] and wire[4], and to determine the differences between such objects and flying insects, since the bat steers away from wires, but towards insects. It gives the bat precise information regarding the sizes of openings so that it can decide whether a safe passage can be made or not. As would be expected, it fails to identify the presence of a fine mesh net or of a mass of fine material backed by a solid object (hair on a person's head). On the whole, it appears to be a wonderfully successful sixth sense for all conditions which a bat encounters in its natural state.

Interruption of the Supersonic Tone

A problem which deserves consideration concerns the interruption of the supersonic note. How is this interruption produced? Is it done intentionally or accidentally? If intentionally, what use is made of it by the bat?

That the interruptions are intentional is shown by two facts: (1) bats can produce an uninterrupted note (usually of about 7,000 cycles per second); and (2) the rate of the interruptions when these are present can be varied, being increased when obstacles are close ahead and reduced again when such obstacles have been safely negotiated. The benefit to be obtained by varying the rate will be considered shortly.

That the interruptions serve a valuable purpose can readily be understood by considering the case of a continuous note, which is reflected without cessation from surrounding objects into the bat's ear. These reflected waves will usually be far weaker than the source itself, particularly when they come from small objects like threads, wires or flying insects. In consequence, while the source itself is sounding, these weak reflected waves may easily fail to be observed. Particularly would such be the case if the source were placed close to the ears in the same animal. By the use of an interrupted source emitting short pulses of sound waves, these difficulties are avoided; since the reflected waves will reach the ears between the pulses of emitted sound waves, that is, during the silent intervals. Two things are obvious: that the source of the sound must be shut off as sharply as possible, in order not to interfere with the reception of the reflected waves; and that it is beneficial to increase the rate of the interruptions as an obstacle ahead gets closer and increased accuracy of localization is required. It is probably for this reason that bats increase the rate of the interruptions when critical steering is necessary.

Bat's Hearing

The cochlea of the bat is histologically similar to that of other mammals, but in several important respects it has been adapted for special uses. Thus it is cast at a higher frequency. Whereas the audible limits for man are from about 16 to 16,000–20,000 cycles per second, those for the bat were found by Galambos to be from 30 to 98,000 cycles per second. Further, whereas the hearing of man falls off in acuity with increasing steepness above about 5,000 cycles, the hearing of a bat is still acute at 60,000 cycles.

The middle ear of the bat has a particularly well-developed reflex called by Galambos the intra-aural muscle reflex[6]. This consists of the contraction probably of both the tensor-tympani and stapedius muscles. This reflex has an inhibiting effect on sound transmission through the middle ear. Galambos found that as a bat dies there is, roughly five minutes after respiration has ceased, a marked rise of the cochlea potentials which are produced by intense supersonic tones. A similar change occurs after administering curare. He interprets these facts as follows. That there is a reflex in normal bats reducing the audibility of intense supersonic tones. In consequence, when this reflex is abolished by paralysing the muscles concerned, either by asphyxia or curare, there is a rise in intensity of the sound heard by the animal.

If Galambos' interpretation of his experimental results is correct, this reflex should be a valuable feature in the sound-localizing apparatus as a whole.

One of the difficulties of the process is that the intense supersonic cry produced by a bat may prevent the recognition of the faint sounds which are reflected back from neighbouring objects. The sudden interruption of the supersonic tone as described above will obviously be a valuable aid in this direction; but this would be even more effective if the bat's ear could be rendered quiescent, or partially quiescent, during the time that the supersonic tone is being produced.

The suggestion has been put forward previously that the supersonic tone may be interrupted by direct muscle action. If the ears of the bat could be rendered less sensitive by muscle action, then these two sets of muscles (those of the larynx and those of the ear) being synchronized, one would have the optimum conditions for sound localization. When the supersonic tone is sounding, the ears would be deaf; and when the supersonic tone is silent the ears would be returned to full sensitivity. Such an arrangement would be of the utmost benefit to the bat. Further research will obviously be required before such a hypothesis could become acceptable.

A further point which deserves mention concerning the auditory apparatus of bats is the very great development of the pinna, which in most species of bats extends like a large flap from the side of the head, the wide open mouth of the pinna pointing in a forward direction.

There is little doubt that a bat can hear quite well when the pinna has been removed, or when this has been replaced by a short length of glass tubing. At the same time, there seems little doubt that an intact pinna adds greatly to the sensitivity of the ear for the reception of sounds coming to the bat from objects ahead of it.

An important function served by the two ears is to provide stereophonic reception. In man this enables the position of objects which are producing sound to be identified with considerable accuracy. Two methods are employed: with low-pitched tones the time of arrival of the sound waves at the ears is the criterion which is used, the nearer ear receiving the sound first; with high-pitched tones intensity plays the major part, the nearer ear receiving the stronger stimulation. With medium pitched sounds both methods are employed[12].

We do not know how bats use their ears for purposes of localization; it may be by time of arrival, by intensity, by phase, or by change of quality.. That the two ears used together play an essential part is shown by the experiments of Galambos and Griffin. "With one ear covered a bat strikes our type of wire barrier almost as frequently as when it is completely deaf." . . . "A few bats refused to fly at all when one ear was covered. Usually such bats land normally on the wall instead of bumping it. They often turned back from the wire or wall, while totally deaf bats practically never did so. This indicates that one ear is sufficient to inform the animal of the general proximity of a large obstacle, but that fine discriminations are almost impossible".

The conclusions that we seem to be justified in reaching as a result of these experiments is that the supersonic beam which a bat emits during flight is reflected (usually in all directions) by external objects. Some of these reflected waves reach the bat's ears and then, by some means at present not known, enable the bat to localize the position of these objects.

Transmission of the Supersonic Note to the Air

Having dealt with the supersonic tone and the probable structures by which it is produced, the following question requires an answer. How is this supersonic tone transmitted to the air? Is it via the nose only, via the mouth only, via either nose or mouth, or via both at the same time?

The facts at our disposal appear to be as follows. Bats have their mouths open during flight. Galambos and Griffin found that if bats are gagged by having a loop of thread tied round their snouts and collodion applied to their lips, the ability to produce the interrupted supersonic note is usually, but not always, seriously impaired, or stopped altogether. When the latter is the case, they fly in a clumsy, hesitant and bewildered manner not noticeably different from that of deafened bats. One bat (No. 37) was an exception, however, for it produced the supersonic note sufficiently well through its nose for it to be recorded electrically, and the flight of this bat was not seriously affected by the gagging[9]. These facts taken together strongly suggest that the supersonic note is usually emitted by the mouth, but may exceptionally be emitted in sufficient strength through the nose.

If this conclusion be correct, it would be expected that breathing would also take place during flight principally via the open mouth and only to a slight extent, if at all, via the nostrils. But there are two facts which make this idea unlikely, or even impossible. (1) Spallanzani[10] found that when the nostrils of bats are plugged they experience acute respiratory embarrassment when in flight, even though their mouths are available for breathing. (2) Most kinds of bat feed on night-flying insects such as mosquitoes, small moths and the like. One object of a bat's flight is therefore to collect food. Since its limbs are being employed for flight, it has to do this with its mouth, which it opens widely for this purpose. The back of the mouth—the fauces—must be kept shut, for otherwise an insect, or part of an insect, might enter the passages by which air gains access to the lungs and cause coughing. If this took place during flight it might have serious consequences, since the supersonic tone would temporarily have to be stopped.

The mouth must not, therefore, be used either for breathing or for the emission of the supersonic tone while it is being used for catching insects. Apart from insects, other foreign bodies float about in the air, for example, parts of plants, and these would be a source of danger to bats if they could pass via the mouth into the air passages. For these reasons the mouth cannot be used for breathing or phonation, and the nose must be used instead for both. This accounts for the finding of Spallanzani that blocking the nostrils caused acute respiratory embarrassment during flight.

How is this conclusion to be reconciled with the experiments of Galambos and Griffin that closing the mouth stops the supersonic tone in most, but not in all, bats?

I think the explanation is as follows. Bat No. 37, which they thought to be the exception, was in fact the rule, and it was the other bats which were the exceptions. This bat could both breathe and phonate, although its mouth was sealed completely with collodion, and in consequence of producing normal phonation its flight was normal. What is the explanation of the behaviour of the other bats which, when their mouths were closed, failed to phonate and therefore failed also to fly without accident? A possible explanation is that they had some nasal defect such as a cold in the head. Such a defect is common in animals kept in captivity, as these bats were.

Assuming that the correct conclusion has been reached about the emission of supersonic sound by the nose, one further point may be mentioned. The snouts of many species of bat are so shaped that they may enable them to produce a kind of beam of supersonic sound energy[13], or at all events may direct the greater part of sound in a forward direction away from the bat's own ears. This would have the effect of improving both the intensity of sound reaching obstacles ahead of the bat, and the sensitivity of the bat's ears.

The Breathing of Bats

Galambos and Griffin have raised an important question when they ask how breathing occurs during the continuous production of the interrupted supersonic tone. That this tone is produced by the vocal apparatus of the throat, and not, for example, by wing vibrations, is shown by their experimental result that bats immersed up to their necks in water can produce the tone, but that bats with their heads momentarily placed under water stop doing so at once.

It seems unlikely that a bat breathes in and out fifty or sixty times per second. How then does it breathe ? I think the answer is that it breathes relatively slowly, say two or three times a second, and that it phonates both during inspiration and expiration. In support of this idea the following facts may be noted. A cat can purr both during inspiration and expiration ; most men can whistle and a few men can sing and hum during both phases of respiration ; a skylark sings continuously without any detectable break, and during the whole time it must be respiring. Probably many other instances could be given. It seems likely that the bat is able to produce its supersonic tone in a similar manner.

Audio-Location and Radar

It is obvious that the basic principles of audio- and radio-location are very similar ; in both cases a beam of wave-energy is projected forward, with the object of detecting the presence and position of objects in the vicinity. In the case of the bat this beam consists of supersonic sound waves, while radar makes use of short electromagnetic waves. The frequency of the sound waves is about 0·05 megacycles per sec., that of the electromagnetic waves is about 30,000 megacycles per sec. The velocity of sound in air being $3{\cdot}4 \times 10^2$ metres per second, the wave-length of the supersonic tone is about 0·7 cm. The velocity of electromagnetic waves in air being 3×10^{10} metres per second, the wave-length of the electromagnetic wave is about 1 cm. Since, other things being equal, the resolving power is inversely proportional to the wave-length, the bat has at its disposal a potential resolving power about equal to that of radar equipment. But conditions are actually more favourable to the bat, since the bat by the employment of its two ears can use stereophonic perception.

A man in an aeroplane can determine the distance away of an object by measuring the time taken for the electromagnetic pulse sent out to return again after reflexion. This pulse has a duration of about one millionth of a second, and, as in the case of the bat, the number of pulses emitted per second is variable. In the bat they vary from 12 to 60 pulses per second ; while in the aeroplane they vary from 200 to 20,000 pulses per second. In both bat and aeroplane, the pulse frequency is raised as obstacles ahead get closer.

The bat may also determine the distance away of objects by ascertaining the time of the emitted sound after reflexion to stimulate its ears.

In the aeroplane the receiver is made insensitive during the radiation of the supersonic pulse. There are grounds for suspecting that the ears of the bat are similarly made insensitive during the radiation of the supersonic tone by a special reflex called by Galambos the intra-aural reflex.

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THE CONCEPT OF MENTAL MATURITY

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IN a recent address under this title[1], Prof. Pear has examined a much-used term. Studying a wide range of examples from modern literature, he has no difficulty in showing that it is employed in very divergent senses, none of them clearly defined. The publication of his lecture is to be welcomed, for it is a delightful addition to his book, "The Maturing Mind"[2]. It is written in the stimulating manner we expect from him, and adds to the hints given in the book as to the rich meaning which he attaches to the term 'maturity'. Above all, it challenges us to endeavour to think more clearly.

In this topic we meet a familiar stumbling-block. Scientific psychology followed upon a long period of popular thinking on psychological matters, and we have consequently inherited a number of words which, though current in general discourse, baffle us when we try to fit them into a scientific framework. We found the word 'attention', which obviously denoted some important mental processes. Years of analysis were needed to discover what they were, and now it appears that we can do without the term. 'Intelligence' has proved even more difficult. Progress would have been more rapid if psychologists had started with a clear field, unhampered by the demand to give scientific precision to non-scientific terms, or to extract clarity from concepts which had been developed for purposes other than ours. We are too socially determined to break away by a single effort. We must accept the situation, and try to bring some order into these untidy ideas. Pear has turned our attention to an important and difficult example of such problems. I would suggest that it would be premature to attempt to give a formal definition or full analysis of 'mental maturity' here and now. A piecemeal process of clearing up is more practicable. Perhaps in the end we shall find that this term is otiose.

I am encouraged to take up the author's implied challenge by his own warm-hearted defence of the second-best[2]. If we lack perfectly clear ideas, may not imperfect ones be better than none ? By scientific standards, the concept of mental maturity cannot be regarded as more than second best; but it is reasonable to suppose that people mean something when they speak of it, though they may be unable to say just what they mean, and though they may convince us that they mean quite different things at different times. Pear could easily riddle me with awkward questions if I asserted that he is mentally more mature than a child of ten, but I am sure that my statement would not be nonsense. I am convinced that I should be employing a useful concept, though I were entirely at a loss when invited to put it into consistent words. I have argued elsewhere[3] that operative concepts are not safely to be judged from their verbal expression. Ordinarily the term 'maturity' implies the application of a criterion which is not stated. It would be wrong to conclude that the criterion is absent and the concept worthless. But better things are expected of psychologists.

Maturity is a terminal point on some kind of scale The position reached by an organism at any moment is judged by the criterion provided by the limit. In the case of a single function of a simple organism, it s commonly easy to find the criterion. Thus an animal is sexually mature when it is capable of eproduction. The criterion here is the fulfilment of a fundamental biological tendency. Since our bioogical systems usually take reproduction as the most mportant single function, it is found convenient to define maturity in relation to it. But this is no final solution, since the simplest organism must have other unctions, essential as carriers of sex, which exhibit development. Nor can we regard a boy in a civilized society as mature for paternity at sixteen.

The problems we are considering become urgent as soon as we view the whole organism in its setting. Yet we can learn from the simple case where the difficulties lie. In zoology, reproduction is taken as the ardinal function. Importance is attached to it somewhat arbitrarily on the ground that the species is a more fundamental and permanent scientific object han the individual. The fuller universe is ignored. This is the ordinary scientific abstraction, necessitated and justified by our incapacity to deal with reality as a whole. Yet the individual must remain alive until it has reproduced itself, and thus requires the development of functions making for the maintenance of life. Consequently we cannot arrive at a completely adequate definition of maturity until we have analysed out all the functions considered important and decided what is the criterion of maturity of each. The more complex the pattern of the creature's life, he more difficult is it to disentangle the essential hreads.

We can, however, now state more definitely the meaning of 'maturity'. An organism is mature when each of its functions is developed to a stage which permits of the achievement of its specific end, and when all the functions are organized to co-operate in attaining that end, which we, for assignable cientific reasons, take as cardinal. It is clear that omething arbitrary remains in this definition, and qually clear, I hope, that there is no humiliation in recognizing that we may find a level of complexity such that we cannot at present make decisive statements in terms of it. We may still judge the organsm's maturity in respect of this or that function, and permit ourselves now and then to talk vaguely, but not carelessly, of full maturity.

From this point, the word 'maturity' will refer to he mental maturity of the human individual. There s no need to enlarge on the complexity of the life pattern. We do not possess a definitive list of the specific strands of activity or of their ends, and if we id we should probably be unable to work with it as coherent whole. More urgent is the question, What shall we take as the cardinal end ? Reproduction, or o know God and enjoy Him for ever ? The answer will affect our system building. But psychology is not competent to decide issues on this plane, and here may never be agreement. The quotations adduced by Pear show plainly that the various writers have been influenced by wider values than hose of empirical science, and the true outcome of is address, as of his book, is a demand for a philoophy of life. To this psychologists may properly ontribute, but they cannot undertake it solely by heir own methods. So for the present we must again fall back on second-best thinking. The individual has o react to his environment, of which we may safely take society to be psychologically the most important. Deriving our criterion from this consideration, we may say that an individual is mature if and when he successfully meets the problems set to him by the society in which he lives (if we could agree as to what constitutes success). We thus accept an ethnocentric standard. We can only judge maturity by behaviour, which does not occur *in vacuo*. It would be unreasonable to demand the capacity to complete tasks which in fact will never be set, there having been no opportunity to learn the appropriate responses. Maturity must be judged by reference to the person's social framework, and the Papuan may be as mature as the European if he discharges as competently the duties which life sets before him. An odd consequence of this argument is that maturity must be allowed to children of all ages, if they successfully meet the demands properly laid upon their age. Actually children often appear surprisingly mature, when one meets them on their own plane. They live in two societies, that of their contemporaries and that of adults. They will appear mature or immature according as we view them in one or the other context.

This criterion is easier to state than to apply in the immense complexity of civilized life. There is a present-day tendency to use the term 'culture pattern' in a free-and-easy way which masks the intricacy of the facts which it denotes. At best we have only a formal criterion, and still lack an analytic description. There will be general agreement that integration is important, and we have hopes of being able in the end to describe it in some detail. Then Pear quotes, with well-deserved approval, Allport's views on the mature personality. He summarizes them thus. "In his opinion, the mature personality should have these attributes : richness, congruence, a variety of autonomous interests, extension and objectivation of the self, a unifying philosophy of life which represents to oneself one's place in the scheme of things and gives a long-range perspective"[4]. This should induce modesty in psychologists. What must *we* be to handle all that' ? And who can be called fully mature by that standard ? Allport's statement is a limiting conception, highly valuable as such, but less useful when applied to the description of particular cases. Moreover, we can only judge maturity by overt behaviour, which is the end-product of the integrated tendencies; and the more complete the integration the less opportunity is there to judge what lies behind. In short, Allport states an ideal of development rather than a working concept, and ideals take us into other fields. And are we not tending to identify maturity with wisdom ? This may be right, but we should amend our neglect to examine the concept of wisdom before we jump to that conclusion. Prof. Pear would add to our debt if he would undertake the task. He has made a useful start by emphasizing the importance of emotional integration as well as intellectual. Then we remember those very wise and well-integrated persons of moderate intellect and restricted experience. Are they mature ? If so, what is the minimum intellectual development required for maturity ? I do not know the answer to the latter question, but I shall continue to respect the wisdom and maturity of the fisherman and the farm worker.

When we have considered the development of specific innate tendencies, their modification by environmental conditions and their systematic integration, there remains one puzzling factor to work into our scheme, and that perhaps the most distinctively human trait. It is the capacity for growth and variation. No concept of maturity can stand that does not allow for it, and yet it cuts across any tidy description of a completed personality. This may be an important source of our difficulties. We demand integration and adaptation; but an integration so complete that all responses are psychologically automatic has gone beyond maturity. The person is over-ripe. Variability must be preserved for adequate living. It is as important as intelligence or emotional development, and must somehow be integrated with them in fact and in theory. We must insist that maturity is not only compatible with, but also includes essentially an intellectual restlessness and a striving for the unattained. When the capacity for development is lost, death has set in. It would be easy to construct a plausible description of maturity which equated it with mental death. We are now on the way to answering one of Pear's questions. The truly mature personality, having retained at full strength the capacity for change and adventure, will consequently appear juvenile, and perhaps capricious. When tasks are not pressing upon him he will become sportive and (at least in the eyes of those already mentally dead) rather ridiculous.

My concept of maturity demands that the mature and wise should at times permit themselves to be silly, and those who dislike the word can look up its etymology. When I was interviewed at the outset of my university career, the principal insisted upon my joining him in shooting at a copy of *The Times* with toy bow and arrows. This was not an early example of 'selection procedures'. He just felt like that, and there were many equally surprising moments in the years that followed. Nevertheless, I rank him among the great and wise of his day. The 'sense of humour' is another facet of this trait, implying a capacity to see things in a novel light, to change relations and to respond in an unexpected way. But admittedly a capacity for the unexpected is poor material for science, and perhaps beyond assessment by exact measurement. So by this route also we only reach what Pear might call 'Tudorbethan' thinking—just better than none at all. But we are gaining control of the concepts of development of specific traits, of integration, and of variation of response. Having these, need we continue to employ a term like 'maturity', which inevitably carries an ethical and emotional tinge? We shall be well advised to use it only with the restricted connotation relevant to the immediate context. Even so, let us bear in mind Aristotle's dictum. "We must be content if we can attain to so much precision in our statement as the subject before us admits of: for the same degree of accuracy is no more to be expected in all kinds of reasoning than in all kinds of handicraft"[5]. It may be added that those who desire to study thoroughly and constructively the nature of maturity might well begin with the "Nicomachean Ethics".

Lastly, encouraged by a recent conversation with Prof. Bott, let me suggest a new turn to the discussion. We judge that a particular reaction is mature. We cannot safely judge that the personality is mature. Though the whole personality may have been brought to bear upon the act, it is not limited thereto. A human personality is extended in time as the physical organism is in space and time. One is no more present at a point in time than is the other at the intersection of certain spacial co-ordinates. It may be convenient to overlook this in rough-and-ready speech. Cross-sections and momentary aspects are indispensable means of knowledge, but they can never give full truth. "Call no man happy until he's dead" is not pessimism but sound science, for the total man has not existed until th moment. So with maturity. The term is applicab to an epoch rather than to an instant. It is a histor not a static quality. We may picture life as an asce to an undulating plateau followed by a drop to zer abrupt or gradual as fate decides. '*X* is mature' w be a true statement if the history of a substanti section of the total life of *X* shows the characte which we deem to be significant. One may occasio ally be permitted to be less austere, but we shall wa in sticky mud if we insist on applying terms appr priate to the full and continuous temporal extensi of personality as adjectives for single moments assemblies thereof. Indeed, until psychologists de far more resolutely than they have done with t temporal aspects of mental life, they must be judg to be scientifically immature.

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SCIENCE IN KWEICHOW AND KUANGSI

By Dr. JOSEPH NEEDHAM, F.R.S.

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AFTER some lapse of time, the opportunity aga presents itself of continuing the series of articl on science in China in war-time, of which seven ha already appeared in *Nature*. In this and the followi article, on China's far south-east, I shall be describi an area which I visited in the summer of 1944, ju before the tide of war overwhelmed nearly all of wrecking many scientific installations, and forci many of the scientific workers I met to take to t roads in evacuation or to the mountains in dispers.

Taking the city of Chungking as the central poi of China, this area is China's south-eastern quart To enter it the traveller must follow the southe road from the capital, winding over half a doz passes through the protecting mountains, until reaches Kweiyang, the capital of the relatively barr and rocky province of Kweichow. A few hundr kilometres south-east of this city is Tushan, the ra head of the uncompleted Kweichow-Kuangsi railw and here he may entrain for the descent throu mountains wreathed in cloud to the fertile plains a rolling hills of Kuangsi around the city of Liuchc The capital of Kuangsi is, however, farther east, Kweilin, amidst that extraordinary scenery of 'Kar limestone pinnacles and sugar-loaf hills rising abrup out of the plain which justifies to the incredulo foreigner the fidelity of Chinese scroll-paintin Thence the railway goes on the east, bearing nor to Hêngyang and then south to the tempora railhead at Kukong in Kuangtung.

Between Chungking and Kweiyang at a small to called Tsunyi is to be found Chekiang Universi one of the best four in China. Housed largely in and dilapidated temples, there is not enough ro for all of it at Tsunyi, so the scientific faculties situated at a very pretty and very small town, Meit some 75 km. away to the east. It is typical of t present transport situation in China that althou the University started with three trucks and a to maintain its communications, all have long ago broken down and are unrepairable and unreplaceable, o that eminent and aged scholars such as the deans f faculties on their necessary journeys have to perch n the top of loaded army trucks on a trip which may take two days, over a road passing through very ew inhabited places.

The president of Chekiang University is Dr. Chu Ko-ching, China's leading meteorologist, who is concurrently head of the Academia Sinica Meteorological nstitute. At Meitan one finds a hive of scientific ctivity. The Biological Department, headed by Dr. Bei Shih-Chang, a pupil of Spemann, Harms, and Hertwig, has been working on induction phenomena in regeneration in cœlenterates, insect hormones, etc. Here also at the time of our visit was the eminent eneticist Dr. Tan Chia-Chen, whose work on the curious colour-pattern inheritance in ladybird beetles is now arousing much interest in the United States, where he has gone for a year's visit. In chemistry here are Dr. Wang Bao-Rjêng (a pupil of J. F. Thorpe's), working on sulpha-drug derivatives (some of which have been found to be active as plant-growth hormones), and Dr. Wang Chin, a specialist on microanalysis and the history of Chinese alchemy. This very active-minded group is completed by Chang Chi-Kai, a German-trained specialist on local anæsthetics, and by Sun Tsung-Pêng, American-rained biochemist.

In physics, work is proceeding mostly on theoretical ines owing to lack of apparatus, in nuclear physics, geometrical optics, etc.; but the level is distinctly high (Drs. Wang Gan-Chang, an Edinburgh man, King Hsu-Bao, Ho Tsêng-Lu, a pupil of Millikan's, and the promising Chêng Kai-Djia). There is a special mathematical institute directed by the geometer Dr. Su Bu-Chin.

The Agricultural Research Institute, with a large area of experimental plots, is also doing much work. Dr Lo Têng-Yi, in biochemistry, has discovered a ugh vitamin content in the large hips of the local wild rose *Rosa multiflora* (20 mgm. ascorbic acid per gm., and 30 mgm. vitamin P per gm.), and some 35 mgm. per gm. of vitamin P in the Chinese 'date', or 'jujube' as it should be called, *Zizyphus vulgaris*. Dr. Bai Han-Hsi, in the fermentation division, is studying the interesting Kweichow 'barm' used in making the famous 'mao-tai' wine, which, besides its yeast, contains no less than twenty-eight special added drugs, some of which accelerate saccharification while others probably inhibit contaminating micro-organisms. This recipe is an extraordinary example of a procedure with centuries of trial and error work behind it, ensuring good results under country conditions where no sterilization precautions are taken. It even has a war importance, for a certain proportion of the power alcohol used by Allied military trucks upon the roads of China is distilled from spirits prepared in the traditional way by the farmers, and brought to central distilleries. In soil science, under Dr. Pêng Chien, investigations on soil pH are in progress, and on trace elements, nickel, zinc, etc., with special reference to tea, legume, and vegetable culture.

In Tsunyi, there is also the All-China Sericultural Research Institute, where very solid work, led by Dr. Tsai Bao, goes on.

At Kweiyang, a larger town than either Tsunyi or Meitan, we found a number of scientific organizations. The largest was the Army's Emergency Medical Service Training School in a beautiful wooded valley among hills called Tuyünkuan; but besides this there were two civilian medical schools, Hsiangya Medical College and Kweiyang Medical College. There was also the Kweichow University, situated some 20 km. to the west of the town in the famous park of Huachi. There was a branch vaccine laboratory of the National Epidemics Prevention Bureau, a branch of the National Agricultural Research Bureau, a number of important industrial enterprises including a low-temperature carbonization plant and a chlorate plant, and several plants of the Ordnance Administration. About 150 km. to the west, at a pretty town called Anshun, there was the regular Army Medical College. Finally, within Kweiyang city, there was the Provincial Science Institute. Among such a wealth of worthwhile institutions, there is space to mention only a few salient points of interest.

The Tuyünkuan College was originally organized by Lieut.-General Robert Lim (Ling Ko-Hsing), the internationally known Edinburgh physiologist. It trains all grades of medical workers for the army, alternating laboratory courses with experience in the field. Dr. Chen Wên-Kuei's model vaccine plant and bacteriological laboratory deserve mention; Dr. Ling Fei-Ching is studying the penicillin production of the indigenous strains of *Penicillium*. An interesting and valuable X-ray apparatus repair station (the only one in China) is directed by her husband, Dr. Rjung Tu-Shan. In teaching chemistry, Dr. Li Kuan-Hua has organized extremely ingenious semi-micro methods which it was a pleasure to see in use by his classes. The reagent sodium tungstate was being manufactured here. The Hsiangya Medical College (Dean Chang Hsiao-Chien, a pupil of Krogh's) had some wretched buildings; but excellent men, such as Dr. Chêng Wên-sse the pharmacologist, studying the Chinese drug 'Yadantze' which has an emetine-like action in dysentery. The Kweiyang Medical College (President Li Tsung-Ên, trained at Glasgow) has the distinguished pathologist Dr. Li Yi, and among her colleagues the American-trained embryologist Dr. Chang Tso-Gan. The psychiatrist Ling Ming-Yo represents a field hitherto little cultivated in China. Both these medical colleges were running up-to-date teaching hospitals.

Two of Zinsser's pupils in Kweiyang, Dr. Wei Hsi, of the National Epidemics Prevention Bureau branch laboratory, and Dr. Liu Pin-Yang of Hsiangya, were engaged upon a very interesting project, namely, the cultivation of typhus Rickettsia bodies in the cœlomic fluid of silkworm larvæ and pupæ (in which good growth is obtained) instead of the yolk-sac of the chick embryo. If this method could be used successfully, it would greatly simplify the preparation of the Cox vaccine under Chinese conditions, where incubators are not available but silkworms are.

The regular Army Medical College at Anshun (director, Lieut.-General Chang Chien) is located outside the town on an airy moorland in a spacious old Ching dynasty barracks, with the various institutes scattered around in scenery like that of the Scottish Highlands. The most important institutes are those of bacteriology, directed by Major-General Li Chen-Pin, and of nutritional science, under Dr. Wan Hsing. Li Chen-Pin, when at the Rockefeller Institute in younger days, carried out classical work with T. M. Rivers. Rivers and Goodpasture were the first to cultivate viruses on the chorio-allantoic membrane of the chick embryo; Rivers and Li were the first to cultivate them (vaccinia and yellow fever) on explanted fibroblasts. Yellow fever vaccine is still prepared in this way. Unfortunately, lack of equipment prevents much research in these institutes, though manufacture of vaccine goes on. The pharmaceutical institute maintains a model factory in which there is a certain production of drugs, and there is a good pharmaceutical garden and farm under Dr. Kuan Kuang-Ti. The Army is planting in Szechuan hundreds of thousands of saplings of the tree *Dichroa febrifuga*, from which is derived the drug 'changshan', known in the Chinese pharmacopœia at least as far back as the Sung dynasty, and recently found in both London and Chicago to have a parasitocidal action in animal malaria.

One of the best types of institution in the Chinese development of the sciences has been the provincial science institute. Reference has already been made to certain of these seen in other provinces; but the one at Kweiyang, directed by Dr. Ling Shao-Wên from the Emergency Medical Service Training School, was extremely good. For popular education there were really good exhibits of parasitology, highway engineering, war gases, embryology (including man), geology and mineralogy, and nutrition. A splendid room, prepared by Mr. Liu Ting-Wei, a great authority on the subject, demonstrated the life-cycle of the Kweichow wax-insects, allied to aphids. This indigenous industry gives a large annual production of highest-quality wax, and both the insect life-cycle and the industrial methods are very curious. The Provincial Science Institute also manufactured scientific apparatus for schools, and had been planned with spacious centralized laboratories for school practical work; but in war-time it had proved impossible to equip them.

If the exhibitions at the Kweiyang Science Institute were the best I had seen, the apparatus manufactured at the Kuangsi Science Institute was the best of its kind. A good many reading machines, for use with the microfilmed journals sent out by the British Council and the State Department of the United States, have been made here. The Institute, which had an excellent building, adjoined those of Kuangsi University (president, Li Yün-Hua, a chemical engineer) around a sloping patch of grass in the hills, rather resembling an English village green, at Liangfêng, some 25 km. south of Kweilin. Near by, among groves of pine trees, were the wooden buildings of the Academia Sinica Institutes of Geology (under the internationally known Dr. Li Se-Kuang (J. S. Lee), of Physics (under Dr. Ting Hsi-Ling), and of Psychology (under Dr. Tang Yueh).

When I was there, Dr. Li was particularly interested in the distortions produced in stone under glaciation, analogous to the 'bending' of tombstones, etc. Work was proceeding on palæobotany (Sse Hsing-Chien), ***Kleintektonik*** (Chang Shou-Chang), and mineral ore structure (Wang Yin-Chih). Associated with Dr. Ting was Dr. Parker Chen (Chen Tsung-Chi), the well-known former colleague of Sven Hedin. Away in the hills a very fine terrestrial magnetism station was working; located in a specially built non-magnetic and thermostatic house, it took continuous photographic recordings of all three elements, and possessed excellent apparatus, some of it made in the Institute's own workshops. The smallest of the three Institutes was that of Psychology (really developmental physiology of the nervous system); Dr. Tang was carrying out transplantations on the beautiful transparent tadpoles of *Microhyla ornata*. There was a particularly good library of neurology and experimental morphology, housed in a separate building.

Probably the best scientific department of Kuangs University was that of chemistry. Here Dr. Amo Pêng (Pêng Kuang-Chin) was working hard with hi group on the indigenous plants which contain rubbe in their sap. Several useful new sources in Kuangs have been found, notably the climbing fig *Ficu pumila* and the giant vine *Chonomorpha macrophylla* Many experimental articles have been made from these rubbers.

The other most outstanding scientific institution in Kuangsi province was probably the Ministry o Agriculture's Experiment Station at Shatang, near Liuchow, covering 7,000 acres and comprising many good laboratories. Directed by Dr. Ma Bao-Chih, the translator of 'Sturtevant and Beadle' and other important books, it was a scene of great activity Choosing at random from among the divisions, Dr Huang Liang (economic entomology) demonstrated the bamboo comb designed for use by the farmers to get the caterpillars of the rice skipper, *Parnara guttata*, off the rice plants, and the box coated inside with a sticky mixture of pine resin and teaseed oil, for getting the flea beetle, *Phyllotreta vittata*, off the cabbages. Dr. Chang Hsin-Chêng (a pupil of Waksman) demonstrated the production of inoculum of root-nodule bacteria. Particular attention was being paid to sugar-cane improvement, tung-oil tree (*Aleurites fordii*) culture, rice selection, and storage of citrus fruits. Dr. Huang Rjui-Lun had shown that during the storage of the pomelo or 'yudze', the ascorbic acid content actually rises, up to a maximum. Attention was being paid to naturally occurring insecticides.

Circumstances have forced me to make considerable use of the past tense in this article. It will be remembered that in last year's campaign, the Japanese, starting from Changsha as a focus on the southern edge of the Japanese-held north-east quarter of China, pushed down to Hêngyang, cutting off the far south-eastern provinces, and then successively down to Kweilin, Liuchow, and Nanning, thus acquiring a corridor with Indo-China. From Liuchow they pushed up the railway to railhead at Tushan and a little beyond, but stopped at the frontier of Kweichow, not however without having caused a partial evacuation of Kweiyang. What happened to the scientific workers?

It is sad to have to record that the Liangfêng centre was practically destroyed. The Academia Sinica Institutes evacuated their personnel to Chungking, but lost a great deal of apparatus which could ill be spared. The Library of the Institute of Psychology was almost completely lost. Kuangsi University personnel were evacuated into the mountains west of Liuchow and have not been heard of since. Both the Provincial Science Institutes were ruined, that at Liangfêng by the Japanese, and that at Kweiyang, with its laboriously arranged exhibitions, by having Chinese troops quartered in it and being "put in a posture of defence". The Shatang agricultural station was overrun; but it is believed that the records were evacuated in time. It is to be feared that some scientific workers and their families were caught in the congested refugee areas at railhead, where the mortality was appalling. I myself met Mrs. Chou, the wife of the Fukienese physicist Chou Chang-Ning (a Cavendish man), on the station platform at Liuchow just before the fall of Kweilin, and did what I could to assist the onward journey of her and her children. Fortunately, Tsunyi, Meitan, and Anshun were not affected; but Kweichow University was, the students and professors simply setting out to walk, carrying what books and apparatus they could, as if it were a thousand years ago. This University has now re-assembled at Huachi. Hsiangya and Kweiyang Medical Colleges, however, managed to secure some truck transport and moved to Chungking, where they are remaining for the time being.

Western Kuangsi was recaptured early this year from the Japanese, but in a ravaged state. The city of Liuchow, for example, was burnt to the ground. The scientific development of these provinces was just in its opening phase, stimulated by the evacuation from the coastal cities; it has been distressing to see so cruel a frost nip it in the bud.

OBITUARIES

Sir David Milne-Watson, Bt.

A LEADING national industry and a wide circle of friends and admirers will regret the death on October 3 of David Milne-Watson. He was one of those Scotsmen possessed of unbounded energy and enormous capacity for work who, trained as a lawyer, developed great administrative and organizing ability coupled with a facility to understand human nature which made him a great leader of men of all grades of society.

Born in Edinburgh in 1869, he gained two degrees at the University before entering a law office. Something lured him to Balliol College, Oxford, and from there he completed his education at Marburg. He was tempted by politics like many young lawyers of his time and contested the South-Eastern Division of Essex in 1895. Fortunately for the gas industry he was unsuccessful, and though he was called to the Bar in the next year we find him attracted into industry in 1897.

A large statutory company like the Gas Light and Coke controlled by various Acts of Parliament has need from day to day of the best legal assistance: the Company chose Milne-Watson for this work. Once there his administrative abilities developed rapidly; he became general manager in 1903 and managing director in 1916. Two years later he became governor, a position giving him the supreme leadership of the Company. He held this post until April last—a term of forty-eight years with the Company.

This is not the place to trace the development of the Gas Light and Coke Co. under his leadership. It provides a highly efficient service for Greater London north of the river; indeed it stretches from Windsor to the North Sea, and is both the largest and the leading gas company throughout the world.

Milne-Watson became a technician as well as administrator; he appreciated to the full the part that science should play in the gas industry and provided full opportunity both for research and development. He was responsible for the installation of adequately equipped and staffed research laboratories to deal with gas manufacture, tar products and the utilization of gas.

Milne-Watson had the inspiration at an early stage to enlist the co-operation of Sir Harold Hartley, and the edifice created between them has placed the gas industry in the forefront of those industries which by research work in all the sciences are continually giving better service to the public. So far from being effete, as is sometimes suggested, the gas industry is in the very forefront of progress, an achievement which redounds very largely to the credit of Milne-Watson.

Milne-Watson realized also the responsibility which lies on a large firm to promote the education of its employees. Every encouragement and special facilities for study were provided, while Milne-Watson himself served on several important committees dealing with education. As the leader of the gas industry in Britain he could not escape a large share of the co-operative work required by the industry, including the relations with labour; and here again his high qualifications made him a member of many national labour inquiries, committees and conferences, including the International Labour Office at Geneva. Space prevents reference to his many other activities, for he was unsparing of his energies in helping national and public causes.

But it is essential to stress his human qualities. He had the widest possible circle of business friends, to whom he was never too busy to give a word of kindly advice or lend a helping hand. In his own Company he prided himself on being the 'father' of a great family. Though forthright in utterance, he was a very lovable and much respected man. He became a knight in 1927 and a baronet in 1937, and had two sons and a daughter.

E. F. ARMSTRONG.

Dr. A. Lees

DR. ANDREW LEES, of the Projectile Development Establishment (Ministry of Supply) and University College, Swansea, died suddenly, after only a few days illness, on August 29, in his thirty-fourth year.

Dr. Lees was born on November 30, 1911. He had a brilliant career at University College, Nottingham, taking the B.Sc. with first-class honours in mathematics, winning the Lubbock Prize awarded by the University of London, and then taking the M.Sc. with a mark of distinction. His research work in quantum mechanics gained him a scholarship at Trinity College, Cambridge, where he studied under Prof. P. A. M. Dirac, who described him as possessing a quite unusual imagination and power of abstraction. Dr. Lees obtained the Cambridge Ph.D. degree, and was then appointed to the staff of University College, Swansea, but he had only been there about two years when war broke out.

After a short period in the Army, Dr. Lees was transferred to the Projectile Development Establishment at Cardigan. Owing to the requirements of official secrecy, details of his work there cannot be given; but it is allowable to say that as a member of the ballistics group he made several valuable contributions to the theoretical and practical aspects of the external ballistics and fire control of anti-aircraft and other weapons. In his spare time he continued his researches in quantum mechanics and related branches of mathematical physics; at the time of his death he had two papers accepted for publication and he was engaged on a third. His correspondence shows that he had many ideas which he was hoping to develop as soon as he could be released from war duties, and his published work would, in all probability, have been considerably augmented if he had been spared for even a few more years.

We extend our deepest sympathy to his widow and two young daughters.

H. T. H. PIAGGIO.

NEWS and VIEWS

Prof. F. E. Weiss, F.R.S.

On November 2, Prof. F. E. Weiss will be guest of honour at a meeting attended by botanists and other men of science in the rooms of the Linnean Society of London to celebrate his eightieth birthday. It is doubtful whether any other man of science in Britain has exerted a greater influence over botanical research and teaching for so long a period as Prof. Weiss has; many botanists and other men of science owe much to his sympathetic guidance and encouragement in their formative years, and, with this in view, the Editors of *Nature* wish to add their contribution to the many messages of esteem which will assuredly greet him on this occasion, for Prof. Weiss has been a contributor to *Nature* over a very long period. But it was at Manchester where Prof. Weiss's main work was carried out: he was George Harrison professor of botany in the University there for thirty-eight years. We cannot do better than quote from the resolution adopted by the University Council on the occasion of his resignation from the chair in 1930: "During his tenure of the Chair he has built up a great School of Botany, which bears a distinguished name both at home and abroad. It is renowned for the researches which have been carried out by the members of the School and for the unusually large number of men and women it has trained who now occupy positions of influence in many spheres of botanical work." At Manchester, Prof. Weiss was also closely concerned with the development of the University itself, especially during 1913–15 when he was vice-chancellor.

On his resignation, Prof. Weiss moved to the south of England—not to rest, but to carry on much useful work with that zeal and understanding which always characterized his work at Manchester. The Linnean Society itself owes much to him—he was president during 1931–34. He has also influenced practical horticulture—he always has been a keen gardener—through his membership of the Council of the Royal Horticultural Society. The British Association owes much to the wise counsel and mature judgment of Prof. Weiss, especially since his release from academic duties at Manchester gave him more time to work for the advancement of science in general. He was joint honorary secretary of the important Committee on Post-War University Education which was constituted by the Association and which issued its report in 1944. It is doubtful if a man of Prof. Weiss's active and alert nature would ever consider resting in spite of a personal history of work for cultural advancement of which any man could be proud; we wish, therefore, to extend our congratulations to him on this occasion, and hope that science and education in general and botany in particular may long continue to have the advantage of his stimulating influence.

Institute of Agricultural Economics, Oxford: Retirement of Dr. C. S. Orwin

Agricultural experts throughout Britain, and indeed over a wider area, will learn with regret that Dr. C. S. Orwin is due to retire at the end of this year from the Institute of Agricultural Economics at Oxford. He was its first director, and from the outset he started it on lines which have since proved very fruitful. He adopted the method of getting right down to the working details of farming by keeping farmers' account books and working out costs of different operations under different conditions, and he published detailed descriptions of the methods of some of the more outstanding farms, especially where new lines have been struck out. In addition, he published an interesting account of the working of the old three-field system, and also of the reclamation of Exmoor. More recently he has devoted his attention to the replanning of British agriculture and village life, and has made some very thoughtful contributions to this important subject. His recent survey of a section of Oxfordshire is a brilliant example of this type of work. In these social and historical investigations he has been ably assisted by his wife, who is herself an expert on these subjects. Not the least of his services has been the training of a staff, some of the members of which have since rendered distinguished service in other institutions. His many friends will wish him long, pleasant and active years of retirement.

Agricultural Engineering Record

The contents of the first number of *Agricultural Engineering Record* provide a good example of the intended scope of this publication, the main purpose of which is to place on record the results of the testing, experimental and research work of the National Institute for Agricultural Engineering, Askham Bryan, York (London: H.M. Stationery Office. Pp. 32. 1*s*.). The subject selected for special review is segmented sugar-beet seed. This process, which originated in the United States, breaks up the seed clusters before sowing by means of a machine, thereby facilitating singling later. Tests carried out on large-scale observation plots in England are described, from which it appears that there was no difference in the yields of beet grown from segmented and natural seed. Another article gives the results of measurements of grain losses with the combine harvester, showing that such losses can easily be of an order which makes the process uneconomical; and it is suggested that attention be paid to improvements in the general design of the cutter-bar, as it is here that the greatest source of loss occurs. Comparative tests with three machines used in sugar-beet harvesting indicated that each was superior to the others in at least one respect, and work is in progress on the production of a composite machine. Grain bin ventilation, a grain flow meter, a coulter for ploughing-in straw and an offset potato-digger form the subjects of the shorter articles, and the number concludes with what is intended to be the chief feature of the publication, namely, summaries of the National Institute's test reports of implements or machines specially imported for research purposes, or experimental prototypes not yet in production.

National Research Council (Canada): Post-War Planning

The twenty-seventh annual report of the National Research Council (Canada), for 1943–44, includes the report of the acting president, Dr. C. J. McKenzie, the financial statement for the year ended March 31, 1944, and reports from the directors of the several divisions, amplifying the information contained in the preliminary review of the work of the Council already issued (see *Nature*, 155, 737; 1945). Referring to the broader aspects of post-war planning for scientific research, Dr. McKenzie's report states that in a brief review of research programmes in Canada, Great Britain, United States and the U.S.S R. it was observed that Canada had hitherto been largely a research importer, and that the Dominion's pre-war *per capita* expenditure of research was far below that of other industrial nations. It is suggested that Canada, through its National Research Council, should maintain in the immediate post-war years a programme of research equal to, or greater than, the present war research effort, which is five times as great as that of the pre-war years. Consideration has been given to a long list of topics suggested as subjects for research in the post-war period, and suitable action indicated. Among many new problems suggested to develop the natural resources of the Dominion or to improve living conditions of the people may be mentioned road research, housing and building research, transport by air, rail, road and water, cold weather and northern latitude problems and the utilization of agricultural crops and products of the forest. Research is recommended on the construction, heating, lighting etc., of small homes, the development of cheap refrigeration units for farm homes, cold-storage locker systems for farms, and farm equipment including plumbing and farm-power units.

It is recognized that the universities must remain the chief centres for training scientific personnel in special fields and should be the chief centres for pure research, although such research must be fostered to a limited extent in the Council's own laboratories. The chief concern of these laboratories should be research on problems expected to yield results for immediate practical application, and provision should be made for this work to be carried to the stage of pilot-plant operation. Provision for the interchange of research workers between the National Research Council, universities, Government departments, and other research organizations in Canada is strongly recommended, as well as the development of research intelligence and the international exchange of research information. The establishment of liaison officers in London and Washington is noted as a policy which might be profitably extended in the post-war period. The value of such co-operation in war research is specially stressed in this report, which notes that it has been possible to plan research with some understanding of the use likely to be made of the results by the Allied Nations, and also it has enabled Canadian workers to discuss their problems at first hand and to establish close relations with other scientific workers investigating similar problems.

New Map of the Moon

MR. H. PERCY WILKINS is a well-known observer of lunar features and has done a considerable amount of very useful work in this particular branch of astronomy. In 1932 he published his 200 in. map of the moon, and now he has brought out a new map which is 25 ft. in diameter and by far the largest map of the moon in existence. It is contained in 107 sheets, each 22 in. by 30 in., bound in three volumes and deposited in the Library of the British Astronomical Association, Burlington House, Piccadilly, London. This map was commenced in 1932 and displays a great amount of care and attention to details—the number of ring-like objects is about 60,000, and many other objects are noted. The number of named objects is 700, including 28 new names; all the names contained in "Who's Who in the Moon" have been included. A large number of new clefts have been inserted as a result of the author's own observations since 1932. Although positions are mainly based on Saundor's list, Mr. Wilkins has made many new measurements with a micrometer, especially of objects near the limb. The large scale—300 in. diameter—is just sufficient to show clearly minute details in the more crowded regions. It is proposed to publish the map on the reduced scale of 100 in. to the moon's diameter, in 25 sections, each 20 in. square, and for the purpose of this reproduction the entire map was re-drawn to this scale, one-third of the diameter of the original sheets. Selenographers will find this map of the moon invaluable for their work.

Trapping Fleas

A. H. AL-HUSSAINI, of the Department of Zoology, Farouk I University, Alexandria, has described, in a communication to the Editors, a simple trap for catching fleas. A plate of 7–8 mm. depth and not less than 20 cm. diameter is filled with soapy water; a one candle-power petroleum lamp, with a flat supporting base, is put in the middle of the plate. Fleas being thermotropic and thus attracted by the heat of the lamp, they jump towards it and fall into the plate, where they are rapidly 'drowned' in the soapy water. The great majority of fleas caught by this trap are females. Two possible interpretations to this high percentage of females can be offered: (1) the female seeks a hide to lay its eggs, and the hotter the hide the more favourable it is for hatching the eggs; (2) the numbers may indicate the natural ratio between the females and males in the human flea (*Pulex irritans*), which would thus be approximately 25 : 1.

The Venereal Diseases

A RECENT pamphlet, "People Who Live in Glass Houses", by a "V.D. Orderly" (Harold Thomas) (London: The Central Council for Health Education, 1945. Pp. 80. 9*d*.), gives an accurate account of the common venereal diseases. One would guess that the material was originally used by the author for lectures to young men. As such, and delivered in a breezy 'man to man' style, it was no doubt successful with a certain type of audience; but Mr. Thomas has not achieved the task of translating his message into writing. The lay reader, who is able to accept the style, may not be inspired by the length. There is just too much to be read at a sitting and some of the information, good though it is, is redundant. An orderly in a venereal diseases clinic has a position of great responsibility and is often the friend and counsellor of the patients. Mr. Thomas has obviously made the most of his opportunities for observation of the conduct and mode of life of his patients. We can praise his sincerity and intentions but not his book.

University of Leeds

AT a meeting of the Council of the University of Leeds on October 17, Dr. W. T. Astbury, reader in textile physics in the University, was appointed to the newly instituted chair of biomolecular structure which has been established for Dr. Astbury personally as a tribute to his merit as an investigator. The title of emeritus professor was conferred upon Dr R. W. Whytlaw-Gray, who recently retired from the chair of chemistry. Mr. Wilfred Prest, acting professor in the University of Melbourne, was appointed visiting lecturer in the Department of Economics and Commerce during the second and third terms of the present session.

The Council announced that the following grants to the University had been made: (1) £10,000 over a period of ten years by the Nuffield Trust to establish a readership or senior lectureship in the Dental School for the purpose of encouraging research into problems of dental health. (2) An annual grant of £600 for seven years from Messrs. Turner and Newall for the institution of a research fellowship to promote research in engineering, chemistry, physics, textile industries or any allied science approved by the donors. (3) £1,500 a year for two years from the Bradford Dyers' Association, Ltd., for the institution of two research fellowships: one in dyeing in the Department of Colour Chemistry and Dyeing; and one in Textile Finishing in the Department of Textile Industries; together with a grant of £400 to each of the two Departments for the maintenance and replenishment of their resources; (4) £300 a year from the International Wool Secretariat for the establishment of a Wool Research Scholarship. (5) 6,500 dollars from the Rockefeller Foundation for the purchase of equipment in the United States required in connexion with Prof. Astbury's researches on the analysis of biological tissues, in support of which the Foundation has made a grant of £2,140 a year during the past twelve years. (6) An annual grant of £100 from Williams (Hounslow), Ltd., for equipment for the proposed new lectureship on lakes and pigments in the Colour Chemistry and Dyeing Department. (7) £750 from Messrs. Babcock and Wilcox, Ltd., for equipment to be used in the Coal Gas and Fuel Industries Department in the training of fuel technologists.

German University in Prague

It is announced by *The Times* correspondent in Prague that, by a presidential decree dated October 18, the German University in Prague and the German technical colleges at Prague and Brno will cease to exist on November 17, the day on which the country commemorates the shooting of Czech students and the closing of Czechoslovak universities by the Germans in 1939.

Ministry of Labour and National Service: Technical and Scientific Register

Demobilized men and returned prisoners of war who are scientific workers, professional engineers, architects or surveyors, are invited by the Ministry of Labour and National Service to make use of the service provided by the Technical and Scientific Register of the Appointments Department of the Ministry, at York House, Kingsway, London, W.C.2 (Telephone: Temple Bar 8020). A technical staff, competent to give advice and assistance, has been augmented to meet problems of settlement and reconstruction. A large variety of vacancies, both at home and overseas, is now available for fully qualified men of science, engineers, etc. Inquirers are particularly asked to write or telephone for appointments, stating occupation, qualifications, and the purpose of the proposed visit.

Fiftieth Anniversary of the Discovery of X-Rays

To commemorate the discovery by Röntgen of X-rays on November 8, 1895, a series of meetings has been planned by the Royal Society, Royal Society of Medicine, Royal Photographic Society, Physical Society, Institute of Physics, Institution of Electrical Engineers, British Institute of Radiology, and Society of Radiographers acting together. On November 8, inaugural meetings will be held at the Royal Society and the Royal Society of Medicine, at which Sir Henry Dale and Lord Horder respectively will preside. During the morning of November 9 papers on "Applications of X-Rays to Physics and Chemistry" will be read at the Royal Institution, and there will be a meeting at the Royal Society of Medicine for lectures on "Diagnostic Radiology" and "Radio-Therapy". During the afternoon, at the Central Hall, Westminster, a joint meeting of the participating societies will be held at which Sir Lawrence Bragg will speak on "The Scientific Consequences of Röntgen's Discovery of X-Rays". During the morning of November 10, papers will be read at the Royal Institution on "Applications of X-Rays to Physics and Chemistry". The remainder of the day will be occupied with meetings at the Institution of Electrical Engineers: the Society of Radiographers will hold a medical meeting, and later there will be two general sessions to hear historical reviews covering X-ray equipment, X-ray photographic materials and industrial X-ray analysis.

The Night Sky in November

New moon occurs on Nov. 4d. 23h. 11m. U.T., and full moon on Nov. 19d. 15h. 13m. The following conjunctions with the moon take place: Nov. 2d. 12h., Jupiter 4° S.; Nov. 2d. 20h., Venus 4° S.; Nov. 6d. 17h., Mercury 5° S.; Nov. 23d. 13h., Saturn 2° S.; Nov. 24d. 03h., Mars 0·6° S.; Nov. 30d. 05h., Jupiter 4° S. Occultations of stars not fainter than magnitude 6 are as follows: Nov. 15d. 19h. 33·9m., 24 B. Ceti (*D*); Nov. 21d. 22h. 05·7m., 3 Gemi. *m* (*R*); Nov: 22d. 5h. 53·5m., 36 B. Gemi. (*R*); Nov. 28d. 1h. 58·3 m., ν Virg. (*R*); *D* and *R* refer to disappearance and reappearance, respectively, and the times refer to Greenwich. Mercury is unfavourably placed for observation, setting about half an hour after the sun during the month. Venus is conspicuous as a morning star, rising at 4h. 44m., 5h. 30m. and 6h. 19m. at the beginning, middle and end of the month, respectively. Mars, in the constellation of Cancer, can be seen in the late evening hours, rising at 21h. 13m., and 19h. 49m. at the beginning and end of the month. Jupiter, in the constellation of Virgo, is visible in the morning hours. The planet rises at 4h. 37m. on Nov. 1 and at 3h. 14m. on Nov. 30. Saturn, in the constellation of Gemini, rises about the same time as Mars at the beginning of the month and at 19h. 16m. at the end of the month. The planet is stationary on Nov. 6. The Leonid meteors are due on Nov. 13–14 and the Andromedids about Nov. 20–27, but both these showers have been very feeble, or in some cases practically non-existent, for a number of years.

Announcements

Sir John Boyd Orr, M.P., has been elected rector of the University of Glasgow.

Captain Arthur Dyce Duckworth, R.N., has been appointed secretary of the Institution of Naval Architects in succession to the late Mr. G. V. Boys, and will shortly take up his duties at the Institution.

The Conference in Prague on the use of X-ray methods in the metal industry (see *Nature* of October 20, p. 473) has been postponed and will take place during November 28–December 1.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Electrical Resistance of Liquid Metals

THE electrical resistance of a metal arises from the scattering of the electron waves passing through it. The fraction of these electron waves scattered in ll directions in a unit volume, which will be called the attenuation coefficient, μ, is equal to the reciprocal f the mean free path of the electrons. From this he specific resistance ρ can be calculated from the ormula

$$\rho = \frac{h}{n\nu e^2\lambda} \cdot \mu, \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where ν is the number of atoms per unit volume, n is he number of conduction electrons per atom, and is the wave-length corresponding to the Fermi urface.

In the alkali metals in the solid state, this wave-length is 14 per cent greater than the wave-length hat will give the first Bragg reflexion in the backward direction. In a recent paper[1], we have shown that this magnitude for λ is sufficient to make the scattering coefficient *even in the backward direction* conform to the Einstein-Smoluchowski formula

$$\left.\begin{aligned} E_\varphi &= \varepsilon \, . \, \nu\sigma_\varphi, \\ \varepsilon &= \nu kT\beta \end{aligned}\right\} \quad . \quad . \quad . \quad (2)$$

where E_φ is the scattering coefficient in any direction making an angle φ with the direction of motion of the electrons, defined for unit volume and for unit solid angle; β is the isothermal compressibility, and σ_φ is the scattering coefficient for a single isolated atom. (σ_φ will be proportional to the square of the atomic structure factor as usually defined.) T is taken to be sufficiently large in comparison with the Debye temperature for the thermal energy to be regarded as proportional to kT.

The attenuation coefficient will then be given by

$$\mu = \int_0^\pi E_\varphi \, . \, 2\pi \sin\varphi d\varphi \quad . \quad . \quad . \quad . \quad (3)$$

$$= \quad \varepsilon \, . \, \nu\sigma, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

where $\sigma = \int_0^\pi \sigma_\varphi \, . \, 2\pi \sin\varphi d\varphi$ is the cross-section of the atom for scattering in all directions.

In the alkali metals in the liquid state also, λ is about 13 per cent longer than λ_0, where λ_0 is the wave-length for which the first diffraction maximum is in the backward direction, $\varphi = \pi$. Though the diffraction halo of the liquid is much more diffuse than the Bragg reflexions in the solid, the above magnitude of λ is still sufficient to exclude all the intense parts of the halo. A portion of its long tail, however, extends into the observable range, $\varphi < \pi$. This forms an excess scattering in the neighbourhood of the backward direction over that given by (2), and hence μ will be in excess of the value determined by (4) by a corresponding amount. On calculation, this extra scattering in the liquid is found to account for the observed increase in resistance of about 50 per cent of the alkali metals on melting. (The increase due to changes in β and ν on melting is relatively small, about 10 per cent.)

Since the method adopted for this calculation is general, and is applicable to polyvalent liquid metals also, we will briefly describe the method here. Denoting by x_φ and s_φ the quantities in X-ray scattering analogous to E_φ and σ_φ respectively in electron scattering, we have

$$\frac{x_\varphi}{\nu s_\varphi} = \frac{E_\varphi}{\nu\sigma_\varphi}, = R_\varphi \text{ say.} \quad . \quad . \quad . \quad (5)$$

Now x_φ, s_φ and R_φ involve φ and λ through $\sin \frac{1}{2}\varphi/\lambda$ alone. Hence knowing the intensity distribution in X-ray scattering by the liquid metal, and the X-ray atomic structure factor, for any convenient wave-lengths, we know R_φ. The Fermi electronic wave-length for the metal is also easily calculated; for this purpose we regard *all* the valency electrons as conduction electrons. If now the atomic structure factor for the scattering of electron waves of this particular wave-length is known, the electronic scattering coefficient E_φ for the metal in different directions can be calculated, and thence, using relations (3) and (1) respectively, the attenuation coefficient μ and the specific resistance ρ can be calculated.

We have calculated the electrical resistances of some typical liquid metals by this method, using the known distribution of intensity in the X-ray diffraction pattern of the liquid[2] and the known X-ray atomic structure factors. Data for atomic structure factors for electron scattering for such low-velocity electrons as are involved in conduction are available for the rare gas atoms only[3], and they have been adopted roughly as the appropriate values for the corresponding alkali atoms in the metal. For other atoms, for want of similar data, the electronic scattering coefficient of the atom σ_φ is assumed to be the same in different directions, and equal to $\sigma/(4\pi)$.

Now plotting R_φ against $\sin \frac{1}{2}\varphi/\lambda = \xi$, say, it is found that in all liquid metals there is one prominent maximum for R_φ, the value of this maximum being about 2 or 3. When ξ is increased further, R_φ falls below unity, and after two or three oscillations about the value $R_\varphi = 1$, with progressively diminishing amplitudes, settles down at this value. As we proceed from the prominent maximum to smaller values of ξ, in most liquids R_φ falls quickly to a very low value, which according to the theory must be the Einstein-Smoluchowski value $R_\varphi = \varepsilon \ll 1$, and must remain so at all smaller values of ξ. In a few liquids, for example, zinc and aluminium, R_φ passes through a subsidiary maximum, before falling to ε.

Now the attenuation coefficient, and hence the resistance, of a given liquid metal will depend on how much of the diffraction pattern, the intensity of which is highly concentrated in the neighbourhood of the prominent halo, is included in the range $0 < \varphi < \pi$, or $0 < \xi < 1/\lambda$, where λ is the Fermi wave-length of the metal. In monovalent metals this range includes little beyond the Einstein-Smoluchowski region; whereas in the other extreme case when the valency is sufficiently high ($n = 5$ or 4), it includes the whole of the diffraction pattern where R_φ deviates significantly from unity. For intermediate valencies ($n = 2$ or 3), the region includes the major portion of the prominent halo, but not the whole of it.

We may mention here one striking result to which we are led by these considerations. Whereas in monovalent liquid metals the attenuation coefficient is of the order of the Einstein-Smoluchowski value, namely, $\mu = \varepsilon \times \nu\sigma$, in polyvalent liquid metals it approximates to what may be called the Rayleigh value, namely, $\mu = \nu\sigma$, which is much larger. The experimental values for the electrical resistances of liquid alkali and noble metals verify the former value, and those for liquid bismuth, lead and tin the latter, with reasonable values for σ.

The exceptional electric behaviour of mercury is due to the following circumstance. Its prominent diffraction halo, which is very sharp, is much closer to the centre than in other liquids; the spherical zone in phase space the boundary of which corresponds to this maximum can accommodate only 0·9 electrons per atom, whereas in the other liquid metals studied this number varies from 1·2 to 1·7 per atom.

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[1] *Proc. Nat. Acad Sci India*, in the press. We owe to Frenkel the idea of calculating the coefficient of electronic scattering in a metal in terms of the thermal fluctuations in density.

[2] For collected data, see Gingrich, N. S., *Rev. Mod. Phys.*, 15, 90 (1944).

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Stability of the Earth's Atmospheric Oxygen

AMONG the many ways in which it is scientifically prophesied that the world, as we know it, must come to an end, there is a double 'threat' to the oxygen of the air.

It has been argued (by Goldschmidt originally), and generally accepted, that this oxygen is already much, perhaps a half part, absorbed by iron and ferrous minerals, and must all disappear in the course of time. But those who suggest this neglect the somewhat obvious circumstance that the same gravitational differentiation which separated oxygen from the iron core originally is still in operation, although now as a very slow 'geological' effect; and that, correspondingly, ferric oxide must be dissociated at a certain depth (*c.* 850 miles) provided that oxygen can escape more easily than iron through the molten basalt (as is certain).

Thus, the equivalent volumes of Fe_2O_3 and Fe_2 are 30·5 and 14·3 c.c.; the difference being 16·2 c.c., or at the pressure considered more like 14·6 c.c.; and the heat of formation of Fe_2O_3 (known at 400° C. and not likely to be greatly different, even at 4,000° C., from the specific heat trends, but possibly some 20–60 per cent *less*) is 196,000 cal. ($= 8{\cdot}23 \times 10^{12}$ ergs): from this the dissociation pressure is $8{\cdot}23 \times 10^{12} \div 14{\cdot}6$ dynes cm.$^{-2}$. Now, down to the depth considered, the changes in gravity (some 10 per cent) and magma density are not great and tend to cancel one another; so that, for a surface basalt density of 3·3, the ratio

$$\frac{8{\cdot}23 \times 10^{12}}{14{\cdot}6 \times 3{\cdot}3 \times 981} \rightarrow 1{,}372 \text{ km., or 857 miles, gives a}$$

satisfactory estimate. It is very good confirmation of this that a heavier silicate-iron layer has been much supposed to begin at a depth of 1,350 km.

The ruddy aspect of Mars has been cited as evidence of advanced formation of ferric oxide; but appropriate calculation shows that the pressure even at the centre of Mars is considerably less than that required for the dissociation—so that the cases are not analogous.

The other 'bogey' in this matter, though a slender one in its rate of action, is accredited equally or more definitely. It is argued that oxygen escapes kineti ally from the 'top' of the atmosphere, at a rat according to Maxwell's distribution law, of son $10^{-\text{hundreds}}$ gm. sec.$^{-1}$. This is no doubt the case; bu what seems to be neglected is that much more oxyge is indrawn gravitationally. Even granting the latt at present, the 'escapists' would argue that it mu escape somehow some time into 'infinite space'.

Now infinite space without a corresponding exte sion of matter is an archaic notion no longer accredite philosophically, or substantiated by observation (far as it goes); and the gravitational oxygen intal is approximately $\pi\left(\frac{\gamma m}{v^2}\right)^2 \cdot v \cdot \rho_{O_2}$ (assuming the ca ture radius $\frac{\gamma m}{v^2}$ to be virtually operative although it only 1/15 of the earth's radius, and that the su rounding oxygen density ρ_{O_2} is 10^{-25}), which amoun to about $1{\cdot}8 \times 10^{-3}$ gm. sec.$^{-1}$—a quantity unque tionably greater than the kinetic loss. (In the ca of the moon, or of Mercury, the kinetic loss is th greater and the earth loses hydrogen to the poi observed.)

Lest it should now be argued that too much oxyge in the air would be almost or quite as bad as none it can be shown that all the oxygen supposed to b in space (ρ_{O_2} near the sun is about 10^{-25}) can neve increase the atmospheric content by more than abou 23 per cent. For the solar space cell contains abou $1{\cdot}13 \times 10^{31}$ gm. of oxygen; and at a solar velocit of 20 km. sec.$^{-1}$ relative to its surroundings (it i probably less owing to similar movement of gas), th sun takes in gases 4×10^{10} times as fast as th earth, thus leaving only $2{\cdot}8 \times 10^{20}$ gm. of th oxygen total to accrue to the earth, which at presen has $1{\cdot}3 \times 10^{21}$ gm. (For a solar velocity relative t the gas of 10 km. sec.$^{-1}$ the possible increase woul be only 3 per cent.) A similar relation will hold fo any other gas, such as nitrogen or argon. Also th earth's iron core may act in a 'buffering' fashion absorbing most of any excess over the presen amount of oxygen.

The theological importance of the question of th future habitability of the earth was the origin of th studies here described—which evidently dispose of a reason for suggesting that the atmosphere is no permanent.

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Thermal Decomposition of $HgCl_2$ Vapou

IN a recent communication, Gaydon[1] has show that an absorption spectrum obtained from mercur chloride ($HgCl_2$) in a heated steel tube by Rao[2], an attributed by the latter to diatomic HgCl (not to b confused with calomel (Hg_2Cl_2) which does not exis as a gas), is really due to CuCl (present as an im purity). It is the purpose of this communication t show by thermodynamic calculation that there is n chance at all of obtaining the absorption spectru of HgCl from thermally decomposed mercur chloride vapour. The same is true for HgBr an HgI. This may be surprising, because numerou diatomic radicals are known; for example, OH

NH, CN, CuH, CuCl, CaH, CaF, CaCl, BeF, MgF, MgCl, ZnF, CdF, AlF, AlH, SnF, PbF, PbCl, MnF, FeCl, the presence of which in thermal equiibrium at high temperatures has been ascertained by their absorption spectra. The rather exceptional position of the diatomic halides of mercury is primarily due to their small energy of dissociation, he value of which is 24,000 cal./mol. in the case of HgCl[3] and still lower for HgBr and HgI.

The free energy functions $(G^0-E_0{}^0)/T$ are accurately known for Hg and for Cl_2[4]. They can also be calculated with sufficient approximation for HgCl and for $HgCl_2$ vapour by using the molecular data published by me[3] and by Wehrli[5] respectively. These values at $T = 1{,}000°$ and 1,500° K. are given in Table 1.

TABLE 1. VALUES OF $-(G^0-E_0{}^0)/T$ IN CAL./MOL. DEGREE

T°K	$HgCl_2$	HgCl	Cl_2	Hg
1000°	74 06	64·67	55 45	42 83
1500°	79 71	68 16	58 88	44 85

The equilibrium constants K_p given in Table 2, ines 1–3, are then obtained from the equation

$$\log K_p = -\frac{1}{4{\cdot}573}\,\Delta G^0/T, \text{ where } \Delta G^0/T = \Delta E_0{}^0/T + \Sigma\,(G^0-E_0{}^0)''/T - (G^0-E_0{}^0)'/T.$$

($\Delta E_0{}^0$ is the heat of reaction of the (ideal) gases at 0° K.; the sum includes the free energy functions of the resultants.)

TABLE 2. DISSOCIATION OF $HgCl_2$ VAPOUR.

No.	Reaction	$\Delta E_0{}^0$ (cal.)	1000° K. K_p	1000° K. α(%)	1500° K. K_p	1500° K. α(%)
1	$HgCl_2 = HgCl + \frac{1}{2}Cl_2$	+ 51,900	$4{\cdot}59\times10^{-8}$	0	$2{\cdot}22\times10^{-4}$	0 5
2	$HgCl = Hg + \frac{1}{2}Cl_2$	− 4,600	$1\ 96\times10^{2}$	99·7	$1\ 02\times10^{2}$	99 4
3	$HgCl_2 = Hg + Cl_2$	+ 47,300	$9\ 00\times10^{-6}$	0·3	$2\ 26\times10^{-2}$	14 9
4	$HgCl_2 = Hg + Cl_2$ (experimental)[6]		$9\ 23\times10^{-6}$	0·3	$2\ 28\times10^{-2}$	14 9

It is seen from Table 2, lines 1 and 2, that in thermal equilibrium a dissociation of $HgCl_2$ into $HgCl + \frac{1}{2}Cl_2$ loes not take place to a measurable degree (α) even at high temperatures, because of the instability of he HgCl radical. On the other hand, the values of K_p calculated for the equilibrium $HgCl_2 = Hg + Cl_2$ line 3) are in excellent agreement (better than could be expected from an approximate calculation) with he experimental values (line 4) obtained by Braune and Knoke[6] from the thermal decomposition of $HgCl_2$ and represented by the equation $\log K_p = 5{\cdot}141 - 10{,}176/T$. At temperatures above 1,500° K. not given here) the dissociation of Cl_2 into 2 Cl has o be taken into account.

A more detailed paper including also the calculaions for $HgBr_2$ and HgI_2 will appear in *Helv. Chimica Acta.*

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Loss of Antimalarial Properties in Quinine Degradation Products

KELSEY *et al.*[1] have described the preparation and properties of a "quinine degradation product" obtained by incubation of quinine with a suspension of rabbit liver tissue, and Mead and Koepfli[2] have reported on the chemical constitution of the product. These workers have not, however, determined whether or not this product is active against malaria parasites. We have therefore carried out the investigations described below on its action against infections of *Plasmodium gallinaceum* in chicks.

Experiment 1. Quinine was incubated with a suspension of rabbit liver, half the suspension being treated with sodium hydroxide prior to incubation to destroy enzyme activity. The untreated and 'control' materials were then extracted with chloroform, in which both the quinine degradation product and residual quinine were soluble. Suitable volumes of the chloroform extracts were measured into ampoules, the chloroform was evaporated off, and the ampoules containing the dry residue were sealed. Groups of chicks infected with *P. gallinaceum* received twice daily doses of the 'test' and 'control' material dissolved in the requisite volume of dilute hydrochloric acid immediately before administration. The extract from the suspension treated with sodium hydroxide contained 1·7 mgm. of residual quinine per ml.; that from the untreated suspension contained no unchanged quinine.

Experiment 2. Using a larger quantity of liver, a sample of the pure degradation product was prepared by a method similar to that of Kelsey *et al.*[1]; the melting point of the product was within 1° C. of that reported by them. The antimalarial activity of this sample in dilute hydrochloric acid solution was determined in comparison with that of a similar dose of quinine.

The results of the antimalarial tests are tabulated below. Only two birds were used in each group because of the small quantities of metabolic products available.

Expt. 1			Expt. 2		
Mean % red cells parasitized			Mean % red cells parasitized		
Untreated suspension	NaOH-treated suspension	Undosed controls	Quinine degradation product	Quinine	Undosed controls
83	0	71	84	82	88

These results show that the peripheral parasitæmia of chicken malaria is not reduced by administration of an extract of liver suspension in which all the added quinine is metabolized (and therefore presumably containing the quinine degradation product), nor is it reduced by doses of the pure degradation product. It may therefore be inferred that after administration of quinine in malaria treatment, a proportion of the alkaloid is converted by the liver of the host into an inactive metabolite. The amount of alkaloid converted *in vivo* is probably much greater than is converted in liver suspensions.

This metabolizing of quinine, with consequent loss of antimalarial activity, might be borne in mind in designing new derivatives or synthetic products of the cinchona type. We have indications, for example, that, while quinidine is metabolized similarly to quinine, cinchonine and cinchonidine are not metabolized by liver suspensions (chick liver). Mepacrine and plasmoquin also appear to be unchanged by rabbit liver suspensions.

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A Convenient 'Bridge' for Two-Solution Cells

In the setting up of two-solution cells for the measurement of electromotive force, it is not easy to establish a satisfactory junction between the two liquids, so tedious and cumbersome devices, such as the agar jelly bridge, are commonly in use. The difficulty may be overcome, and stable and correct junction potentials obtained within a few seconds, by the simple device of using for the bridge a strip of filter paper, the ends of which dip into the two solutions, which may conveniently be contained in two small beakers resting on a block of paraffin wax.

If the filter paper be used dry, a liquid-liquid junction is immediately set up by capillary rise.

If it is desired to use a third liquid for the bridge, a strip of paper may be soaked in this, and the excess removed before use by pressing between dry filter papers.

If a galvanometer of high sensitivity is in use, a single strand of bleached cotton yarn will form a satisfactory bridge, and the device may be further improved so as to give readings which remain stable indefinitely, by drawing the yarn through a glass U-tube, so as to shield it from evaporation.

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Chromium Oxide as a Promoter in Catalysts for the Fischer-Tropsch Synthesis

The economics of synthesis of hydrocarbons by the Fischer-Tropsch process may be improved by using (1) cheaper catalytic material, (2) water gas as such in place of enriched synthesis gas ($CO : H_2$ as 1 : 2) and (3) medium pressures instead of atmospheric pressures. A cheap iron-copper catalyst prepared by Ghosh and Sen[1] gave 86 gm. of hydrocarbons per cubic metre of gas and has since been developed by Japanese investigators[2]. The fact that chromium oxide possesses very high adsorption for hydrogen at 200° has been taken advantage of in preparing a catalyst ($Co = 34$ per cent; $Cu = 4$ per cent; $ThO_2 = 2{\cdot}3$ per cent; $Ce_2O_3 = 0{\cdot}24$ per cent; $Cr_2O_3 = 4{\cdot}6$ per cent; rest kieselguhr) which has been found to be remarkably steady, and yields with water-gas at a pressure of 5 atmospheres and 205° C. 160 gm. of liquid hydrocarbons per cubic metre with a space velocity of 600 c.c. per hour per c.c. of catalyst.

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[1] *J. Indian Chem. Soc.*, 12, 53 (1935).

[2] Tsuneoka, *et al*, *Sci. Papers Inst. Phys. Chem. Res., Tokyo*, 35, 83 (1938–39); 38, 118 (1940); 38, 184 (1941).

Darkened Violet in Colour Vision

EDRIDGE-GREEN[1] has directed attention to the shortening of the violet end of the spectrum which he found in some persons. A test of sensitivity to red, orange, yellow, yellow-green, green, blue-green, blue, violet and purple was carried out on 103 men and 104 women, excluding all red-green blind and red or green anomalous subjects. The experimen was performed with a form of colorimeter using the Ilford Monochromatic filters (601–8) and purple (501). Relative brightness was measured as well as sensitivity to hue.

Three women and three men had the violet darkened by more than three times the standard deviation of brightness levels of violet for the remaining subjects, which shows that the darkening was not due to norma variation (or random error). A number had slight darkening of violet and blue, but while there was a correlation of + 0·337 between blue weakness and darkening of blue, the correlation between violet weakness and darkening of violet was not significant This means that on the whole there was a tendency for blue to be darkened when it was weakened, while violet was as often brighter as darker when there was loss of sensitivity to its hue.

In this test there were about 10 per cent who had marked yellow-blue weaknesses and were not red green defectives (while the red-green blind are rarely weak in yellow or blue). This confirmed the result of previous tests. The yellow-blue weak subjects were not sufficiently defective to be called blue yellow blind and they were not consistently detected by tests in general use; but they had sometimes suspected a weakness of colour-sensitivity in themselves. Six of the yellow-blue weak subjects were those with darkened violet. Five of them were weak in yellow as well as in blue, and one in blue rather than in yellow. All were weaker in yellow and/or blue than in violet, but not weaker than the yellow blue weak in whom violet was normally bright.

Equality of proportion for both sexes suggests tha blue-yellow weakness and darkened violet are not sex-linked characters, a conclusion supported by genealogical data. Darkening of violet appears to be about as common in each sex as the familiar darkening of red (as in protanopes) among men. Just as, in my experience with detailed tests on about seventy red-green defectives, the protanopes are not 'red-blind' but are red-green defectives with darkened red as an additional character, so those with darkened violet are not 'blue-blind' but are yellow-blue defectives with violet and blue of diminished brightness

Thus, although there are, as Walls[2] has predicted two classes of blue-defectives, namely, those with and those without darkened violet, they are not, as he suggested, products of a shifting of violet sensitivity towards green (darkened violet), and of green towards violet (not darkened), respectively. They appear to be yellow-blue defectives in whom the violet is exceptionally dark.

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Crystalline Hæmolytic Substance from Normal Blood

THE occurrence of a hæmolytic substance in normal blood has been demonstrated by Bergenhem and Fahraeus[1]. This substance was present in the ether precipitate of the alcohol-soluble fraction of serum, and was described by them as a lysolecithin, that is, a derivative of lecithin from which one fatty acid has been split off by the action of lecithinase, an enzyme analogous to that contained in cobra venom. However, the evidence in favour of the existence of lecithinase in serum and of the lysolecithin nature of the lytic substance was indirect, since no attempt at purification or isolation of either the lecithinase or the lytic principle has been reported.

The present work was concerned with the isolation of the hæmolytic substance from human blood plasma. The substance has been purified and finally obtained in a crystalline form. It is free from nitrogen, phosphorus, sulphur and halogen. It is insoluble in water but soluble in ether, and since it is free from nitrogen and phosphorus, it is not a lysolecithin. Molecular weight determination and microanalysis agree reasonably well with the suggested formula $C_{22}H_{42}O_5$; m.p. 45°. 0·1 c.c. of a 5 per cent erythrocyte suspension of human blood in 5 c.c. of isotonic phosphate buffer solution (*p*H 7·2) is completely hæmolysed in about one minute at 37° by 50 μgm. of the crystalline material, that is, in a dilution of 1 : 100,000.

A detailed account of the isolation, purification and chemical constitution of the crystalline material will appear elsewhere.

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Respiration of Spermatozoa in Egg-Yolk Medium

OF various media used in artificial insemination for the preservation of the semen[1], the egg-yolk phosphate mixture of Phillips and Lardy[2] has given the best results, maintaining the fertilizing capacity of bull semen for several days at 5° C. Egg-yolk phosphate is also a good medium for maintaining oxygen uptake of the semen in respiratory experiments, and Walton and Edwards[3] found a positive correlation between oxygen uptake of semen samples and the fertility of the bulls from which the samples were taken. Experiments have therefore been undertaken to determine the factors present in the egg-yolk affecting the respiratory activity at 37° C., in expectation that the knowledge gained will assist in the discovery of the most favourable conditions of storage.

Semen was obtained from the bull by the artificial vagina[4]; 1 ml. of semen was used for each measurement of oxygen uptake in a Barcroft-Dixon manometer[5].

It was found that neither the cell-free seminal fluid nor the egg-yolk, either separately or in combination, gave any appreciable oxygen uptake. Whole semen (cells plus fluid) in phosphate buffer alone gave relatively good respiration. The addition of egg-yolk, however, greatly increased oxygen uptake, but in about one hour's time there was gradual decline. In order to trace the sources of this increase and of the eventual decline, the egg-yolk has been fractionated by various treatments and each fraction tested separately. The first fractionation was achieved by dialysing the egg-yolk in a 'Cellophane' tube at 1° C. against distilled water. Two fractions were thus obtained; the *non-dialysable portion*, which contained the bulk of the egg-yolk; and the *dialysable portion*, which passed through the membrane into solution. Both fractions were made isotonic, the first by re-dialysis against phosphate buffer and the second by evaporation at 50 mm. pressure until the volume was equal to the water content of the original yolk. The non-dialysable fraction gave a slightly reduced initial uptake in comparison with the untreated yolk; but the uptake continued at an almost constant rate for the remaining period of the experiment (3 hr.). The addition of the dialysable fraction to the buffered semen caused a slight initial rise, followed by a marked inhibition.

The two outstanding features of these experiments are: (1) that the non-dialysable portion is capable of maintaining a high respiratory rate over a prolonged period; and (2) that dialysis has removed from fresh egg-yolk a substance or substances which give rise to inhibition of respiratory activity, and that these are present in the dialysable portion. In regard to (1), we have further found that by extraction of the non-dialysable portion of the egg-yolk with organic solvents, both the fat-free protein residue and the re-emulsified fat increase the oxygen uptake when added to the semen-buffer system. There is some evidence that the degree of dispersion and the stability of the emulsion may contribute to the activating or preservative action of the fat in the egg-yolk. The unsaponifiable matter of the fat has a slightly inhibitory effect. In regard to (2), we have further investigated the nature of the inhibitory mechanism. An inhibitor itself is not present initially either in the untreated egg-yolk or in the dialysable portion, but is only gradually formed as a result of the oxidative metabolism of the spermatozoa on a substrate which is present in the dialysable portion. The inhibitor is not formed in the absence of oxygen.

Catalase, in relatively large amounts (at least 10 μgm.), completely reverses the inhibition. Peroxidase in smaller amounts has the same effect. Catalase inactivated by heat, cytochrome *C*, hæmatin, and ferrous ion had slight effects only upon the oxygen uptake and did not reverse the inhibition. Although the presence of free hydrogen peroxide could not be detected by the benzidine-peroxidase test, it is possible that the inhibitor is an organic peroxide and that catalase and peroxidase both reverse the inhibition brought about by this peroxide. The mechanism involved bears some resemblance to the 'coupled oxidations' of the type described by Keilin and Hartree[6]. The substrate of the inhibitor in the dialysable portion of the egg-yolk is soluble in ethanol but not in ether.

Since the non-dialysable portion of the egg-yolk maintains respiratory activity well, tests have been made of its capacity as a storage medium, and a number of cows have been inseminated with semen stored in it. Results are not yet complete, but so far have been satisfactory.

Our thanks are due to Prof. D. Keilin and Dr. T. Mann, of the Molteno Institute, for much help and advice, and to Mr. Rowson of the Insemination Centre for conducting the fertility tests.

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[6] Keilin, D., and Hartree, E. F., *Proc. Roy. Soc.*, B, **119**, 141 (1936).

Thiourea and the Suprarenal Cortex

Rats fed on diets containing thiourea and thiouracil die after varying periods of time. Some preliminary experiments showed that in the case of rats on 0·5 per cent thiourea, the action of the drug was reversible up to a certain stage; but after this, death occurred whether the animals were put back on to the control diet or not. This indicated that thiourea was exerting more than a simple antithyroid effect. Hughes[1] found similar results with thiouracil. We also observed in rats on both thiourea and thiouracil that in the terminal stages (the last two days) the suprarenals were frequently enlarged and dark reddish brown in colour. Except in the terminal stages, however, our findings confirm those of Williams, Weinglass, Bissell and Peters[2], who reported that in rats treated with thiouracil the suprarenals were smaller than normal although the ratio of gland-weight to body-weight was normal.

To test for possible suprarenal cortex deficiency, a batch of 26 young male rats, which had been on diet containing 0·5 per cent thiourea for 28 days and had remained stationary in weight for 14 days, was divided into four groups. All groups received the diet plus thiourea, one group being supplemented with thyroxine (10 μgm. thyroxine daily injected subcutaneously in alkaline saline), one group having 1 per cent sodium chloride to drink instead of tap water and one receiving 1 per cent sodium chloride to drink in addition to subcutaneous injections thrice daily of 0·1 ml. 'Eucortone' (suprarenal cortex extract). The average weights of these animals are given in the accompanying table.

Average weight of rats (gm.)

Group	Days on diet			
	30	60	90	120
Control	105	149	202	
Thiourea	52	All dead		
Thiourea + saline		68	All dead	
Thiourea + saline + 'Eucortone'		92	107	147
Thiourea + thyroxine		96	118	140

Thiourea diet supplemented after 30 days by giving saline to drink saline to drink plus three subcutaneous injections daily of 0·1 ml 'Eucortone' or 10 μgm. thyroxine subcutaneously daily.

All the rats receiving thiourea only died in a short time. The rats drinking 1 per cent sodium chloride gained some weight and lived longer than the rats drinking tap water. Those receiving both 1 per cent sodium chloride and injections of 'Eucortone' showed a remarkable recovery, as did also the rats receiving thyroxine. Although these two groups of rats were gaining weight at approximately the same rate, those receiving thyroxine were sleek and active whereas those on 'Eucortone' were somewhat lethargic. Neither group caught up with the control group in weight. The thyroids of the thyroxine-treated rats were normal, whereas gross and histological examination of the thyroids of the rats treated with 'Eucortone' showed that these animals were still in a hypothyroid condition. The growth of these animals can presumably be attributed largely to retention of water and increased food-intake. One rat treated with thiouracil, which had remained more or less stationary in weight for thirteen weeks, also recovered after injecting 'Eucortone' (0·1 ml. thrice daily). In six weeks, this rat increased in weight from 116 gm. to 164 gm. and was then killed for histological examination.

The results of these preliminary experiments indicate that both thiourea and thiouracil produce suprarenal cortex deficiency in rats. This view is supported by the fact that histological examination of the suprarenals of rats in the terminal stages frequently revealed abnormalities in the cortex including severe congestion, particularly of the zona reticularis, depletion of lipoids (stainable with Scharlach R), hæmorrhages and sometimes areas of necrosis. The glycogen contents of the livers were also considerably reduced.

The exact mode of action of thiourea and thiouracil on the suprarenal cortex has not yet been established.

I am indebted to Dr. C. L. Oakley, who carried out all the histological examinations.

Gertrude E. Glock.
Wellcome Physiological Research Laboratories,
Langley Court, Beckenham, Kent.
May 16.

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[1] Hughes, A. M., *Endocrinol.*, **34**, 69 (1944).

[2] Williams, R. H., Weinglass, A. R., Bissell, G. W., and Peters, J. B., *Endocrinol.*, **34**, 317 (1944).

Palolo Worms

I have been much interested in the communications in *Nature* concerning the palolo worm, sent by Commdr. William Burrows[1] and by Mr. R. A. Leven[2]. I should like to direct attention to the paper published nearly forty years ago by W. McM. Woodworth, in which the distribution, habits, structure and history of the palolo are fully discussed. It was published in 1907 in the *Bulletin of the Museum of Comparative Zoology*, 51, No. 1, 1–21, pls. 1–3. As it was based largely on Woodworth's own observations, it is of real importance and should not be forgotten or overlooked.

Hubert Lyman Clark.
Museum of Comparative Zoology,
Cambridge, Mass.

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[1] *Nature*, **155**, 47 (1945).

[2] *Nature*, **156**, 19 (1945)

RESEARCH AND DEVELOPMENT IN THE BRITISH COLONIES

UNDER the title "Colonial Research 1944–45"[*], there have now been issued the second annual reports of the Colonial Research Committee and of the Colonial Products Research Council, and the first annual report of the Colonial Social Science Research Council; for convenient record, these reports will in future be published in a single volume. Following on the reports of the Commissions on Higher Education in the Colonies and in West Africa (see *Nature*, Sept. 27, p. 373), they assist materially in appraising the recommendations of those Commissions in regard to Colonial research; and although the Colonial Research Committee's report is not concerned with fundamental principles of policy to quite the same extent as its first report, the present report is of scarcely less general interest.

With the establishment of the specialist research committees, the main work of organization in Britain for Colonial research may be said to be well advanced. The main bodies, including a forthcoming committee for Colonial agricultural, animal health and forestry research, are directly advisory to the Secretary of State, who nevertheless looks to the Colonial Research Committee for advice on general research policy, and the Committee considers that its future work lies rather in certain co-ordinating functions which only a centrally placed body can perform. It has, first, to ensure so far as possible that no important field of inquiry is overlooked because it does not fall well within the scope of one or other of the specialist bodies; and, secondly, to maintain a proper balance in the allocation of effort and funds.

The first function is comparatively simple, and the Committee instances the study of the needs of housing research, for which purpose a Colonial Housing Research Group, with Dr. I. E. Evans of the Building Research Station as chairman, was established. The Committee is also proceeding to a study of the needs of zoological and botanical surveys, in so far as these fall outside the direct scope and interest of agricultural and veterinary research. Other subjects mentioned as worthy of attention are: road research, a study of the power resources of the Colonies of all kinds, potential as well as actual, and the possible application of land utilization survey techniques. In regard to the second function, while the sum of £500,000 made available for research under the Colonial Development and Welfare Act of 1940 has so far been substantially underspent, and with the Act of 1945 that provision becomes £1,000,000 a year, the possibility of any financial limitation of Colonial research effort seems remote, since the Committee proposes to adhere to its policy of supporting only well-conceived schemes for which adequate and suitable personnel are available. Nevertheless, the end of the War will release many research workers, and the proposed research services alone may be expected to cost substantial sums, even if Colonial governments make some contribution. Moreover, plans laid and decisions taken now are likely to have a very important effect on future trends of research policy; and, discussing the choice of the precise means to be adopted, the Committee points out that even the urgent problems do not always yield most readily to a frontal assault. The key to a particular problem, or indeed to a whole complex of problems, may lie in fundamental work in some apparently quite unrelated field. In terms of Colonial needs, it may sometimes be wisest to concentrate effort in the laboratory best equipped to deal with the key problem, wherever that problem may be; and how to discern such key problems is in itself a major problem to the solution of which the Committee proposes now to address itself.

Reviewing the fields of research, the Committee endorses the recommendations of a sub-committee of the Colonial Survey and Geophysical Committee for creating a central organization designed to complete the whole of the geodetic and major framework and half of the outstanding topographical work, making the utmost use of aerial photography. The Royal Air Force is prepared to carry out the air photography on behalf of this survey as part of its peace-time specialist training. The Committee also endorses the recommendations of a Committee on Colonial Geology for a central organization on similar lines, and the two sets of proposals provide an unrivalled opportunity of supplying the Colonies with a thorough and accurate basic knowledge of their most important resources. The Committee has also recommended a capital grant towards the cost of the fisheries research station being installed in Mauritius, as well as the acceptance of the proposals of the Colonial Fisheries Advisory Committee for the formation of a Colonial fisheries service, to be recruited on terms of service analogous to, and interchangeable with, the federated superannuation system for universities.

The Committee considered a full report from an *ad hoc* sub-committee of the Colonial Advisory Council of Agriculture, Animal Health and Forestry, and supports its recommendation for the establishment of a separate committee of specialists to advise on research in these fields and to take over such functions from the Council itself. This recommendation has been accepted by the Secretary of State. A second recommendation, that in the Colonies themselves research should be organized on a regional rather than a territorial basis, has been commended to Colonial Governments, and a third recommendation for the establishment of a separate research service on the lines proposed for the fisheries service has been deferred for consideration by the new Committee. Schemes were also made for continuing the low-temperature research station at the Imperial College of Tropical Agriculture, for research on animal diseases in the Bechuanaland Protectorate, and for a survey of animal diseases in Zanzibar.

No specific schemes for medical research involving substantial expenditure were before the Committee during the year, but schemes were made for continuing studies on the bionomics of *Anopheles gambiæ* in Sierra Leone and Nigeria, and for D.D.T. field trials, for which £4,500 was provided. The latter scheme points the way to what may become a major development in tropical preventive medicine; workers in Africa, advised and guided by Prof. P. A. Buxton, have shown that D.D.T. is toxic to the tsetse fly. Important trials designed to work out effective techniques for its application in the field have been planned. The Committee has also recommended the adoption of an important scheme for research and development work on growing cinchona in the Colonial Empire, based in East Africa; in regard to medical research in general, the Committee considers that, so far as central organization is concerned, the way is now clear for a rapid and systematic attack on the major medical problems of the Colonies. It is pointed out, however, that research cannot be prosecuted effectively in this or in any other field without a regular flow of skilled men of science, and, unless energetic steps are taken, one of the chief shortages is likely to be in the field of entomology.

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[*] Colonial Research 1944–45 1. Colonial Research Committee, Second Annual Report, 2 Colonial Products Research Council, Second Annual Report; 3. Colonial Social Science Research Council, First Annual Report. (Cmd 6663.) Pp. 32. (London . H M Stationery Office, 1945.) 6*d* net.

Other special committees established are the Tsetse Fly and Trypanosomiasis Committee and the Cocoa Research Committee, while with the aid of a grant of £28,000 now made on the recommendation of the Committee, it is intended to place the Anti-Locust Research Centre on a more permanent and satisfactory basis. Under the direction of an advisory scientific committee, the Centre will carry out a development programme covering the collection and dissemination of information (in close collaboration with the Imperial Institute of Entomology), research and technical advice in the conduct of specific campaigns. Proposals for continuing and extending the work of the Discovery Committee, which has done magnificent work on the oceanography and marine biology of the southern seas, were also considered. A list of schemes recommended and finally approved during April 1, 1944–March 31, 1945 is appended.

The report of the Colonial Products Research Council refers to the visit of Sir Robert Robinson and Prof. J. L. Simonsen, the director of research, to the West Indies; they were accompanied on most of their tour by Dr. A. King, head of the British Commonwealth Scientific Office in Washington. Further insight into American methods of industrial development was obtained during visits to Puerto Rico and St. Thomas, and during a visit to Trinidad a detailed programme of research was worked out with Trinidad Leaseholds, Ltd., while it was suggested to the directors of the British West Indies Sugar Association (Inc.) that the formation of an industrial research organization for sugar technology might be of great value. In a visit to British Guiana, it was suggested that difficulties being encountered in schemes for agricultural development owing to the high incidence of malaria in the coastal strip offer an ideal opportunity for an experiment on the use of D.D.T., and according to preliminary reports the experiment has met with a measure of success. Correspondents with the director of research have been appointed in all the Colonies of the Caribbean. A major development during the year was the decision of the Council to open a Microbiological Research Laboratory in Trinidad; Dr. A. C. Thaysen has been seconded to work under the Council and direct the research of this new laboratory, which it is anticipated will provide a centre for fundamental microbiological research in the tropics.

Reviewing research work in progress, the report refers to the investigation of expressed lime oil, which has been shown to contain limettin, *iso*pimpinellin, bergaptol and 5-geranoxy-7-methoxycoumarin, and these crystalline constituents are now being examined as antioxidants. Work on the reactions of eugenol and its derivatives from clove oil has been actively pursued, and at the Chemical Research Laboratory of the Department of Scientific and Industrial Research Dr. L. P. Walls has studied the most suitable methods for determining the ergosterol content of yeasts and for its extraction. Work on the utilization of sucrose has been actively pursued under the direction of Prof. W. N. Haworth and Dr. L. F. Wiggins, attention being directed mainly to lævulinic acid, hydroxymethylfurfuraldehyde, and to the dianhydrides of mannitol and sorbitol. A large number of new substances prepared appear likely to find application as chemotherapeutic agents or in the plastics industry. Work has also been commenced in the starch field, while in that of theobromine some attention has been given to the reaction of chlorotheobromine with diamines as a route to high polymers and to a process for reducing the theobromine content of cocoa meal to about 0·1 per cent by solvent extraction after treatment with ammonia. The utilization of Wallaba wood resin and the study of vegetable oils from Colonial sources have also received attention, and a list of some important plants found in the Colonies which are likely to have medicinal or insecticidal interest is undergoing final revision.

The Colonial Social Science Research Council, which was constituted in June 1944, held eight meetings during the period to March 31, 1945, covered by its first report. The general functions of the Council comprise broadly the review of the organization of research in the social sciences in the Colonies, the scrutiny of research projects submitted to it, the making of recommendations as to the publication of the results of research and the initiation of research in fields not otherwise covered. The Council was constituted to represent the main branches of the social sciences; but economic research is covered by the Research Sub-Committee of the Colonial Economic Advisory Committee, the chairman of that Sub-Committee being a member of the Council.

Attention is directed in the report to the need for certain types of basic data as being fundamental to many of the inquiries with which the Council is concerned, for example, the provision of sound demographic data, including census and vital statistics.

Further, the great bulk of the material required for effective study of the form and operation of political and administrative institutions consists of records in official archives, which at present are not always readily accessible without interfering with administrative work. The Council has also devoted much consideration to the attempt to ascertain what are the main research problems in the various fields, and what order of priority should be attached to them. While a comprehensive research programme has not yet been formulated, several problems have been recognized as major research needs. There is urgent need, for example, for surveys of social and economic conditions in urban and in rural areas; for comparative studies of local government; for studies of the social and economic effects of migratory labour in Africa, of land tenure in relation to agriculture and social structure, of Colonial administrative law, particularly in respect of procedure in native courts, of political development in 'plural' communities; and for sample surveys of literacy in relation to programmes of mass education. A wide range of intensive research on individual languages and cultures of many Colonial peoples is also required.

Attention has also been given to the organization of research. For some time to come, much research in the social sciences in the Colonies must be undertaken by individual workers; but the Council realizes the value of the more integrated organization provided by local or regional institutions specifically adapted for research into social problems, and believes that more institutes such as the Rhodes-Livingstone Institute and the Sociological Department of the West African Institute of Industries, Arts and Social Sciences will be necessary. The Council has so in mind the need for close integration, first with the practical knowledge and requirements of governments as expressed in development and welfare programmes, and in the work of administrative officers nd officers of the specialist services, and secondly, ith the research programmes of other organizations n the same field. Reference is made, however, to he present extreme shortage of senior research workers fitted for independent and responsible investigation in these fields; the Council considers that or some time to come it will be necessary to draw most of the workers required from Britain. To enable any comprehensive programme of social research to e undertaken, postgraduate training of research workers on a long-term basis will be necessary, presumably at the universities; but in the present emergency the Council contemplates the provision of hort-term training, appropriately planned with the ultimate objectives in mind and financed under the esearch section of the Colonial Development and Welfare Act. Reference is also made to the real problem which the future career of the research worker may offer, and the scarcity of openings when the investigator has completed his specific project.

Of specific research projects examined by the Council, reference may be made to work on the handbook of African languages, the ethnographic survey n Africa, research work on economic and social spects of Colonial policy during the war period and Dr. R. R. Kuczynski's "Demographic Survey of the British Colonial Empire".

INDIAN FISHES AND FISHERIES

DR. SUNDER LAL HORA has added much, and is still adding, to our knowledge of the fishes of India. In a series of papers published during 1942 onwards, sometimes in association with other authors, he has dealt with a variety of subjects.

Discussing the respiratory movements of some Homalopterid fishes[1], attention is directed to the lose parallelism between the accessory respiratory chambers of these and the bucco-pharyngeal hambers of certain air-breathing fishes. The fishes of Poona[2], with their Hindi names and distribution[3], and the fishes of Mysore and adjoining hill ranges[4] are listed. Notes on fishes in the Indian Museum[5] and descriptions of the large-scaled barbels, already discussed in six previous articles, are continued[4,6,7].

In May 1942, Dr. Hora was appointed to the post of director of fisheries, Bengal. One of his first ctivities in this capacity was a thorough investigation into the pollution of streams by the effluent of the quinine factory at Mungpo and its effect on the sh. The report[8] deals with many aspects of the problem, the main conclusion being that the effluent eads to the pollution of the streams affected by it (in the sense that the stream waters do not remain natural) not so much through the chemical waste products contained in it, but by the deposition of bark residues in the form of a coloured flocculent matter of very fine consistency, and by the oil contained in the effluent. Although there may be seasonal depopulation of the streams due to pollution, he fish are not permanently injured and their breeding is not affected. The main recommendations for improvement are, so far as practicable, to remove the bark residues by sedimentation in settling tanks and possibly to recover more oil by skimming the tanks. With the construction of these tanks it may be possible to let out the effluent over a longer period, so that only a small quantity passes through the stream at a time.

Dr. Hora is always an advocate for research in all its aspects, and three of his papers[9,10,11] show the great need for biological stations in India and above all urge the plea for the establishment of a fishery research institute. In post-war reconstruction a central organization to deal with the fisheries of the country is the obvious solution.

[1] *J. Roy. Asiatic Soc. Bengal, Science*, 8, Art. No. 4 (1942).

[2] *J. Bombay Nat. Hist. Soc.*, 43, No. 1 and No 2 (April and August, 1942).

[3] *Rec. Ind. Mus.*, 44, Pt. 2 (1942).

[4] *J. Bombay Nat. Hist Soc.*, 42, No. 2 (1942).

[5] *Rec. Ind. Mus.*, 44, Pt. 1 (1942).

[6] *J. Bombay Nat. Hist. Soc*, 44, No. 1 (1943)

[7] *J. Bombay Nat. Hist. Soc.*, 44, No. 2 (1943).

[8] *Proc. Nat. Inst. Sci. India*, 10, No 1 (1944).

[9] *Proc. Nat. Inst. Sci. India*, 10, No. 1 (1944).

[10] *Proc. Nat. Inst. Sci. India*, 10, No. 1 (1944).

[11] *Curr. Sci.* (April 1944)

CHEMISTRY IN CHINA

THE four volumes of the *Journal of the Chinese Chemical Society*[1] covering the years 1941–44 contain more than a hundred papers on all branches of the science. Many of the papers deal with problems of nutrition, vitamin content of food, fertilizers and soil types in China, and the analysis of Chinese drugs. There are investigations of the properties of vegetable gasoline made from native materials, cracking of vegetable oils, and the oxidation of natural fats and oils. The indican content of Szechwan indigo, the fixation of Chinese valonia by hide powder, and similar problems have been studied.

A large number of papers are of general chemical interest, as distinguished from those concerned with national requirements, and a very good balance is preserved between the various branches of investigation. In organic chemistry, the papers on amino-acids, the synthesis of products from ethyl alcohol, acetaldehyde, from acetylene, ketones, the santonin series, enzymes and sulphanilamide derivates, may be mentioned. Several papers on analytical chemistry, including the use of the polarograph, are of interest. In physical chemistry, the papers are mostly theoretical, dealing with such subjects as ionic volumes, radii and entropies, apparent heat capacities of salts in solution, ionic polarization and refraction, electronegativity and atomic number, viscosity and critical data. Several interesting new equations are proposed relating to these magnitudes. A paper on the temperature of maximum density of heavy water fixes this at 11·21°, in good agreement with other recent investigations. There are some papers on chemical kinetics (iodine monochloride addition and unsaturated acids) and optical rotation.

The standard of the papers is high, and the record of work, some at least of which must have been carried out in difficult circumstances, is impressive. The future contributions of China to chemistry should be of great value if the present rate of progress is continued.

[1] Published by the Society. Annual subscription per volume, 4 U.S. dollars. Inquiries to Dr. F. H. Lee, College of Science, University of Nanking, Chengtu, China.

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Monday, October 29

Institution of Electrical Engineers (at Savoy Place, Victoria Embankment, London, W C 2), at 5 30 p m —Discussion on "Should Engineering Concerns be Managed by Engineers?" (to be opened by the President).

Chemical Society (joint meeting with the Swansea University College Chemical Society) (in the Chemistry Lecture Theatre, University College, Swansea), at 6 p.m.—Prof J. Kendall, F.R.S.: "The Separation of Isotopes and Thermal Diffusion".

Chemical Society (joint meeting with the Local Sections of the Royal Institute of Chemistry and Society of Chemical Industry) (in the Engineers' Club, Albert Square, Manchester), at 7 p.m.—Mr. F. P. Dunn . "The Publications of the Three Chartered Bodies".

Royal Geographical Society (at Kensington Gore, South Kensington, London, S.W.7), at 8 p.m.—Brigadier Bernard Fergusson : "Beyond the Chindwin—the Wingate Expeditions into Burma, 1943 and 1944".

Tuesday, October 30

Chadwick Public Lecture (at the Livingstone Hall, London Missionary Society, 42 Broadway, Westminster, London, S.W.1), at 2.30 p m —Dr Walter P. Kennedy: "Health Education, its Problems and Methods".*

Sheffield Metallurgical Association (at 198 West Street, Sheffield 1), at 7 p.m —Mr A. Muir · "Furnace Automatic Control".

British Institution of Radio Engineers, Scottish Section (at the Royal Technical College, George Street, Glasgow, C.1), at 7.30 p.m.—Dr Paul Vigoureux: "Quartz Oscillators".

Wednesday, October 31

Imperial Institute (South Kensington, London, S.W.7), at 3 p m. —Dr. F. Dixey, O.B.E . "Nigeria, its Geology and Mineral Resources".*

Thursday, November 1

Chemical Society (at Burlington House, Piccadilly, London, W.1), at 5 p.m.—Mr L. Hunter "Mesohydric Tautomerism", Mr. A. G. Foster: "The Sorption of Condensable Vapours by Porous Solids", Part 3. Multimolecular Adsorption, Part 4 Linear Isothermals and the Langmuir Equation; Mr A. Campbell and Mr. J. Kenyon · "Retention of Asymmetry during the Beckmann, Lossen and Curtius Changes".

Royal College of Surgeons of England (at Lincoln's Inn Fields, London, W C.2), at 5 p m.—Sir Arthur MacNalty: "The Renaissance, its Influence on English Medicine, Surgery and Public Health" (Thomas Vicary Lecture).

Royal Institution (at 21 Albemarle Street, London, W.1), at 5 15 p m.—Prof. James Gray, F.R.S : "The Anatomy and Functions of the Brain in Lower Vertebrates" (i) "Fishes".

Institution of Electrical Engineers (at Savoy Place, Victoria Embankment, London, W.C.2), at 5 30 p.m.—Mr. P. B. Frost and Mr. E. F. H. Gould · "Practical Aspects of Telephone Interference arising from Power Systems".

Institute of Welding, Portsmouth Branch (at the Gas Company Offices, Guildhall Square, Portsmouth), at 7 p m.—Mr. W. G. John: "Progress in the Application of Welding to Ship-building".

Friday, November 2

Royal Institution (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Mr. A. C. Hartley . "Laying a Pipe-line under the Channel —Operation Pluto".

North-East Coast Institution of Engineers and Shipbuilders (in the Literary and Philosophical Society's Lecture Theatre, Newcastle-upon-Tyne), at 6 p.m.—Sir Lawrence Bragg, F.R.S.: "Problems of the Metallic State" (Andrew Laing Lecture).

Chemical Society (in the Chemistry Lecture Theatre, University College, Nottingham), at 7 p.m.—Prof. E. L Hirst, F.R.S. "Some Problems in the Chemistry of the Polysaccharides".

Institute of Welding, South London Branch (at the Borough Polytechnic, Borough Road, London, S.E.1), at 7.30 p.m.—Inaugural Meeting. Mr. H. W. G. Hignett: "Some Thoughts on the Weldability of Alloy Steels".

Saturday, November 3

Association of Austrian Engineers, Chemists and Scientific Workers in Great Britain (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 3 p.m.—Meeting of British and Austrian scientists in support of the restoration of Science in Austria.

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned

Photographer to take charge of the Photographic Department—The Secretary, Royal Cancer Hospital (Free), Fulham Road, London, S.W.3 (October 31).

Physicist to assist in work of advisory and employment service for men and women in this profession—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 473, York House, Kingsway, London, W.C.2 (October 31).

Deputy City Analyst—The Medical Officer of Health, Depa ment of Public Health, Kenwith Lodge, Westbury Park, Bristol, endorsed 'Deputy City Analyst' (November 3).

Assistant Constructional Engineers by an important firm Engineers and Contractors for service at home and abroad (should qualified Civil Engineers with experience in Steam, Oil and Hyd Power Stations and Transmission Line Construction)—The Minist of Labour and National Service, Appointments Department, Techni and Scientific Register, Room 670, York House, Kingsway, Londo W C.2, quoting E 1968 XA (November 5)

Teachers (2) of Mechanical Engineering Subjects, and Teacher of Building Subjects, in the Rotherham College of Tec nology—The Director of Education, Education Offices, Rotherha (November 5).

Assistant Lecturer in Mechanical Engineering, and Assistant Lecturer in Textiles preferably with special qualific tions and experience in Spinning—The Principal, College of Tec nology, Belfast (November 7).

Lecturer in Mathematics in Royal Aircraft Establishme Technical College—The Ministry of Labour and National Servic Appointments Department, Technical and Scientific Register, Roo 670, York House, Kingsway, London, W.C.2, quoting A.1143 (November 8)

Lecturer in Civil and Mechanical Engineering, and a Lectur in the Biological Sciences (Botany, Zoology and General Physiolog —The Principal, West Ham Municipal College, Romford Road, Stra ford, London, E 15 (November 10).

Engineering Assistant in the office of the City Surveyor—T City Engineer and Surveyor, Town Hall, Leicester (November 10).

Lecturer in Civil Engineering—By *Air Mail* to the Registra University of the Witwatersrand, Johannesburg, South Afri (November 12—duplicate application should be lodged with t Secretary, Universities Bureau of the British Empire, c/o Universi College, Gower Street, London, W.C.1)

Chief Engineering Assistant—The Chief Engineer, Southe Waterworks Company, 13 Cambridge Road, Southend-on-Sea (Noven ber 15)

Chief Superintending Engineer (Ref. No. C.2840 XA), and Mechanical Engineer (Ref. No. C.2842.XA), for a Paper Mill India—The Ministry of Labour and National Service, Appointmen Department, Technical and Scientific Register, Room 670, Yor House, Kingsway, London, W.C.2, quoting the appropriate Ref. N (November 16).

Geologist by the Geological Survey of the Sudan Governmen for service in the Sudan to carry out general geological surveys an special hydrological and soil erosion studies, also supervision of wat development work—The Ministry of Labour and National Servic Appointments Department, Technical and Scientific Register, Roor 670, York House, Kingsway, London, W.C.2, quoting F 5043 (November 17).

Lecturer (full-time) in the Department of Metallurgy of th County Technical College, Wednesbury—The Director of Educatio County Education Offices, Stafford (November 17).

Assistant Librarian in the College Library—The Registra University College, Leicester (November 19)

Senior Research Metallurgist to the Tata Iron and Ste Company, Ltd., Jamshedpur—The Ministry of Labour and Nation Service, Appointments Department, A 9, Room 670, York Hous Kingsway, London, W.C.2, quoting F 4979.XA (November 19).

Lecturer in Pathology to dental students, and a Lecturer i Physiology to dental students—The Registrar, King's Colleg Newcastle-upon-Tyne (November 24).

Lecturer in Production Engineering, and a Lecturer-in Charge of Coal Mining Department, of the Technical Educatio Branch, Department of Public Instruction, New South Wales—Th Acting Official Secretary, New South Wales Government Offices, 12 Strand, London, W C.2 (November 30)

Technical Assistant in the Electricity Department—Th General Manager, Electricity Offices, Ferensway, Kingston-upon-Hu (November 30).

Research Fellowship to be held at the Bernard Price Institut of Geophysical Research, University of the Witwatersrand—By *A Mail* to the Registrar, University of the Witwatersrand, Johannesbur South Africa (November 30).

Lecturer in Geography, a Lecturer in Physics, and Lecturer in Political Science, in the Victoria University Colleg Wellington, New Zealand—The Secretary, Universities Bureau of th British Empire, c/o University College, Gower Street, London, W.C. (November 30)

Chair of Applied Mathematics in the University of Sydney-The Secretary, Universities Bureau of the British Empire, c University College, Gower Street, London, W.C.1 (November 30 Sydney).

Assistant Mycologist for indexing and editorial work—T Director, Imperial Mycological Institute, Ferry Lane, Kew, Surrey.

Graduate Assistant to teach Junior Mathematics in the Tec nical Day School and Senior Mathematics to part-time and evenn College students, and a Graduate Assistant to teach Geograph in the Technical Day School and Technical College, of the West Hartl pool Technical College—The Chief Education Officer, Education Office Park Road, West Hartlepool.

Lecturer (full-time) in the Department of Mechanical Engi eering—The Principal, · Borough Polytechnic, Borough Roa London, S.E.1.

Teacher of Chemistry and Allied Subjects, and a Teache of Physics, Engineering Science and Building Science—T Principal, Technical Institute, Tunbridge Wells.

Teacher for the Mechanical Engineering Workshop and f Mechanical Engineering Subjects, including Workshop Tec nology, in the Northampton College of Technology—The Ch Education Officer, Education Office, Springfield, Cliftonville, Nort ampton.

Librarian (temporary) in the Department of Agriculture f Scotland—The Regional Appointments Officer, Regional Appoin ments Office, Ministry of Labour and National Service, 5 Rothes Terrace, Edinburgh, quoting Ref. No. 352.M.

NATURE

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CONTENTS

Page
rmy Education : Educating the Educators . . . 513
rigin of Uniformity. By Dr. John Cohen . . . 515
Search of Rigour. By F. Ian G. Rawlins . . . 516
omparison of Enzyme and Immune Reactions. By Dr. P. Johnson 517
PERIAL COLLEGE OF SCIENCE AND TECHNOLOGY
Centenary Celebrations 518
Contributions of the Imperial College to the Conquest of Disease. By the Right Hon. Lord Rayleigh, F.R.S. 520
The Royal College of Chemistry. By Dr. E. Frankland Armstrong, F.R.S. 524
e Army School of Education, Eltham Palace. By Major T. H. Hawkins 527
bituary :
Prof. F. Vejdovský. By Clifford Dobell, F.R.S. . 530
ews and Views 531
tters to the Editors :
Life-Cycle of the Red Corpuscles of the Hen.—Prof. G. Hevesy, For.Mem.R.S., and J. Ottesen . 534
Departure of Long-Wave Solar Radiation from Black-Body Intensity.—Sir Edward Appleton, K.C.B., F.R.S. 534
Indexes of Data for Identification Purposes.—Dr. A. F. Wells 535
Hydrogen Overvoltage as a Factor in the Corrosion of Metallic Couples.—L. F. LeBrocq and H. C. Cocks 536
Difference Tones.—A. J. King 536
Transplantation of the Heart.—Prof. Nikolai Sinitsin 536
Behaviour of the Common Centipede *Lithobius forficatus*.—Capt. J. L. Cloudsley-Thompson . 537
Hatching of the Egg of *Ixodes ricinus* L.—D. R. Arthur 538
Control of Foot Rot (*Phoma* sp.) of Flax.—A. E. Muskett and J. Colhoun 538
Nature, Nurture and Probability.—Prof. Gunnar Dahlberg 539
A Forecast of Solar Activity.—Dr. W. Gleissberg 539
ast Hexokinase and its Substrates *d*-Fructofuranose nd *d*-Glucose. By Dr. A. Gottschalk 540
llon Institute of Industrial Research : Annual Report 541
Radio Navigational Aid 542
changes of Inorganic Ions Through Living Membranes 542
smic Rays : Anglo-French Conference in Bristol . 543
cent Earthquakes 544
osure and Partial Separation of a Metallic Contact . 545

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ARMY EDUCATION

EDUCATING THE EDUCATORS

A CENTRAL institute for the ambitious scheme of education in the British Army has recently been opened at Eltham Palace, Kent (see p. 527)—an occasion which gives rise to certain thoughts and queries about the nature and progress of this all-important aspect of present-day army life. As Major Hawkins, the chief instructor at the new School, states in his article, this "infant which was perfectly conceived some months ago, is now going through all the pangs of infancy". The same can be said of army education in general, for though there have been some attempts at it for several decades, they have been of a rather minor character and so many new projects have arisen *de novo* in recent years that one might say the general scheme of army education is still in its infancy. In bringing up any infant, too many advisers might leave both parents and child in such a state of confusion as to cause disaster; nevertheless, it is to be hoped that the parents of this infant will look for criticism from as many authorities as possible and for a long time to come, for there are many authorities on adult education outside the Army. Furthermore, if the various new schemes for education in the Army are based on sound principles, we may visualize army education in due course proving to be one of the most important of all projects in adult education. In this connexion it is gratifying to note that a number of H.M. inspectors (Ministry of Education) are to give the army education authorities the benefit of their experience and criticism after spending some time examining army education in the field. We trust, however, that these specialists will bear in mind that they are dealing with an experiment in adult education and not school teaching—for there is considerable difference between the two.

This immediately raises a very important point. It is to be hoped that the army authorities will always bear in mind that the principles and practice of education as accepted and applied in all good schools in Britain are not altogether suitable for education in the Army. Neither can army education be compared with university education, not even, we think, in the new 'formation colleges'. The logical corollary to this is that a school teacher is not necessarily the best choice for an army education officer. This must be mentioned, for too often it has appeared to be tacitly assumed that if there is a former school-teacher in an army unit, then he is the obvious choice for dealing with education in that unit. It should be borne in mind, however, that when appointing officers to take over responsibility for education among such a heterogeneous group as an army unit, a former school teacher, though experienced and probably well informed in the principles and practice of education of the child, may not be gifted with the tact, common sense and human understanding so essential when dealing with men. Very different methods of attracting an audience and in presenting the material are required; furthermore, the immediate and ultimate aims are very different also. This is important, for in due course we hope to see the majority of army men genuinely wishing to attend the classes arranged for them; then, and only then, will it be possible to eliminate the objectionable practice of rounding up a sufficient number of men to make up an audience, especially in the case of a visiting civilian lecturer. This practice can never ensure that the right men have been given the chance to derive whatever benefit there might be in attending such lectures. Neither is it calculated to encourage a visiting lecturer to agree to giving his services again. It all boils down, as will be evinced again further on, to the great need for preparing and tending the ground beforehand, and this can be done only by carefully selected education officers who in their turn have the sympathetic guidance and assistance of their seniors.

This raises the more general question of choice of personnel for tackling the problem of army education. The War Office and the Army have the benefit of the advice and help of certain qualified educationists both at the War Office itself and in the Central Advisory Council for Education in H.M. Forces. Individual specialists, too, have given assistance. But, in spite of what Major Hawkins claims in his article, we suspect that army education is all too frequently the victim of that 'red tape' with which the War Office and army life in general are so notoriously fettered. Advice and suggestions are, of course, essential: but it is not much use seeking these if they are to be carried out by army personnel who are not equipped with the necessary knowledge and experience or, worse still, who are periodically meeting the stumbling block of indifference on the part of their senior officers. We would therefore ask: Is the War Office satisfied that all senior officers concerned with army education are qualified in the modern principles of the science of adult education and able to appreciate, understand and carry out the proposals made by those specially qualified to make them? If not, then it seems desirable that the War Office should carefully scrutinize the methods and routine adopted in appointing and promoting army officers to carry out this work.

Of course, it must be realized that the Army is not primarily an academic institute, and army education must dovetail into the other aspects of army life. But such a realization is essential not only among the critics of army education but also among the army educationists themselves, lest the latter bite off more than they can chew and, indeed, trespass on the preserves of others. In war-time, educational schemes must be constantly under revision and subject to modification, sometimes even cancelled in face of more urgent needs—all with understanding and without complaint from the army educationists. In peace-time, this aspect of the problem cannot be so acute; but always must there be sympathy and complete understanding by the senior officers in charge of a unit, including its education officers. They must at any rate recognize the importance of army education, even if they are unable to take part in it, and thus give every facility within their power to the educationists under their command. Some senior men do so, and, in the field, the encouraging influence of their obvious interest in what is going on is s profound as to inspire not only the education officer but also the men to give of their best and to be on th constant look-out for new ideas.

Alas, on the other hand, other senior men seen merely to accept the educational side of arm life as a necessary nuisance wished upon them This is a pity, for then the orders are given an no further interest shown, leading to disconten and bitter feeling among the men who are doin their best for the cultural and technical educatio of the troops under unfortunately trying conditions. Furthermore, such indifference causes irritation among visiting specialist lecturers who a willing to help the War Office in its commendab attempts to raise the standard of education amon our troops. This complaint has sometimes bee viewed differently, and visitors have been accused demanding the 'red carpet to be laid down for them We doubt if this accusation can be made agains many visiting lecturers; they are probably merel resenting the superior and indifferent attitude whic greets them—and rightly so. It is now well know that in an attempt to assist soldiers in retaining an expanding their educational and cultural horizon during the War, the War Office has given facilities t civilian specialists who have agreed to visit the variou units at home and overseas to talk to, and have discussions with, the men in the field. There is no doub whatever that provided the problem is tackled in th correct manner, such a lecturer receives a since welcome from most officers and men. But it must b recorded that at times, before getting at the me themselves, it has proved necessary to break throug the obstacles of indifference and misunderstandi presented by senior officers. It is to be hoped th in due course the War Office will see its way clear rectify this deplorable situation; for it is undesirab that the indifference of a few senior officers shou entail the men losing those cultural contacts th clearly desire through visiting lecturers being di couraged from giving their services. It should made clear by the War Office to all senior officers th army education is to be taken seriously, and not mere treated as one means of giving the men something do during quiet periods, or as a Cinderella amo the multitudinous activities of modern army life.

The task of the Army Educational Corps is "inspire and organize education in the Army But the Army's teachers cannot carry out this t mendous and commendable project unless they a qualified by training or experience or both to do neither can they be expected to give of their b unless inspiration comes to them in the form sympathy and practical assistance and interest fr their seniors. Also, though in due course we mig reasonably expect army education to be organiz and carried out within its own ranks, there shou always be a welcome for the visiting civilian lectur To this end, army education officers *in the field* shou be encouraged to make contact with all acaden institutions within the vicinity of their units, a thus enable more direct cultural contacts to be ma between the Army and the civilian educational bod

These observations from education in the field must be taken into consideration if army education is to be viewed in its correct perspective and a true value assessed. Periodically, for example, there is published a statistical account of single lectures and courses of lectures arranged for H.M. Forces by the Central Advisory Council. This conveys only one aspect of he whole movement. What is also required by those interested is a mass observation of these lectures in action; returns concerning the number of men and women, voluntarily attending such lectures might cause some lifting of eyebrows. (Lectures attended under compulsion cannot reveal very much in this connexion.) The reactions of the men themselves, oo, would tell a valuable tale—one more valuable han a mere record of number of lectures arranged. The figures given by Sir Ronald Adam, adjutant-general to the Forces, in his speech at the opening of he new School, should be interpreted with the same reserve. According to Sir Ronald, about half the units in commands at home, 66 per cent of the field force units in the C.M.F. and 70 per cent of the Rhine Army have begun to implement the education scheme for the release period. Notwithstanding the difficulies of materials, printing and transport, already nearly a million text-books and books for unit and command libraries have been dispatched to formations and units. These figures are impressive, and the authorities are to be congratulated on their zeal. t is not for us to discourage such work this end by aising hares; nevertheless we are still disturbed about the other aspect of all this. Is the War Office satisfied that so far as is humanly possible the right men are in charge of the schemes in the field, and have the best men been chosen for seeing that the maximum benefit is derived from the reading of those million books ?

A similar point of view may be adopted concerning he masses of literature published in the form of pamphlets. The fact that so many hundred thousand A.B.C.A. pamphlets have been published and dispatched reveals little more than the commendable enthusiasm of the authors of them and the efficiency of the army and other authorities in conceiving and devising them. It is the receiving end which really counts, and when one sometimes hears that a pamphlet has been indifferently handled in an officers' mess and then given to one man with orders to 'mug it up' and give a lecture on it the next day, we wonder whether a little more propaganda among the officers in charge and some 'education of the educators' might not so enhance the value of the pamphlets as o render them more commensurate with the time, paper and money spent on them. A bigger harvest might be reaped if one could be sure of the best education officers being left to decide which pamphlets his men need most and then applying for them t some central depot.

Clearly the opening of the permanent home of the Army School of Education at Eltham Palace is symolic of the ambitious plans being formulated by the authorities in the War Office. In order that the projects envisaged may be assured of complete fruition, it would be as well to be sure that the machinery in the field is well oiled with enthusiasm among the education officers and sympathy and understanding from their seniors.

It seems therefore not only desirable but even essential that the main criteria in the choice of an army education officer should be academic qualifications in the principles and practice of adult education, the personal quality of leadership, and a background of educational experience and good record. We would place leadership as paramount among these. Military record and length of service should come very low in the scale of qualifications. We reiterate that the Army is not an academic institution; but where cultural, vocational and technical training is being practised, that training must rank high. It must not be treated with indifference or as of little importance, and all stumbling blocks must be removed. It is good in this connexion to read that at the courses to be held at Eltham Palace "Army Educational Corps officers are to be joined on various courses either by the unit education officers who are concerned with the fine details of the scheme in the units themselves, or by commanding officers who are responsible for seeing that good educational facilities are being provided for men and women under their command". At such courses, the main effort should be directed towards imbuing these officers with enthusiasm: they can easily be *ordered* to provide the facilities, but if they do so with an offhand lack of interest, condescendingly and with a show of indifference, then more harm than good will be done. For this great scheme to succeed, at any rate, in the field, young, enthusiastic and well-trained educationists are required; and their enthusiasm must be encouraged by the all-important sympathetic understanding and vigilance of their seniors.

ORIGIN OF UNIFORMITY

Social Learning and Imitation

By Neal E. Miller and John Dollard. (International Library of Sociology and Social Reconstruction.) Pp. x+284. (London: Kegan Paul and Co., Ltd., 1945.) 15*s.* net.

MOST past studies of learning have been concerned with the acquisition of intellectual or motor habits and skills. The learning process has been studied, so to speak, in a social vacuum. With the subject of imitation, text-books have usually dealt casually, explaining it in terms of current theory, nativistic, 'associationist' or, more rarely, in terms of learning. Familiar phenomena are the ones most liable to be lightly passed over, and it is perhaps just because imitation is so pervasive and universal a process that its significance has been overlooked.

In the present volume we meet the first serious attempt at an experimental approach to imitation. The authors take a new path. They expound the 'reinforcement' or 'reward' theory of learning as applied to (i) learning by imitation and (ii) learning to imitate. This theory is derived directly from the studies of Pavlov, Thorndike, and Watson which have recently been synthesized by Prof. Clark Hull in his "Principles of Behaviour". Unless the reader is conversant with Prof. Hull's work, there is much that he will fail to appreciate in the present volume.

The argument follows the so-called 'hypothetico-deductive' method employed in other publications of the Yale Institute of Human Relations. In theory, this means postulating a small number of plausible assumptions from which certain principles are deduced; experiments are then designed to test whether the principles are in accord with the facts. The actual plan adopted by the authors was as follows. First they familiarized themselves with applying learning theory to social and imitative behaviour, mainly of children in everyday life. A preliminary list of relevant variables was then drawn up which were manipulated in experiments. This led to a refinement of theory, which was applied to such topics as leadership, crowd behaviour, lynching, and diffusion of culture.

Four factors are singled out as operative in learning: drive, response, cue, and reward. All these must be present before learning can take place. 'Drive' means motivation; unless the subject is impelled to act, no learning can take place at all. Likewise, the 'responses' for the act of learning must form part of the psycho-physical equipment of the learner. 'Cues' are distinctive signs which elicit the correct responses. Finally, that response is learned which has been rewarded. Reward reinforces the response by reducing the drive.

The authors distinguish three kinds of imitative behaviour which they name (rather awkwardly) 'same', 'matched-dependent' and 'copying', respectively. In 'same' behaviour, two or more persons react identically (for example, buying tickets) in response to stimulation by the same cue. In 'matched-dependent' behaviour only the leader is able to read the relevant cues, the followers more or less blindly following suit (as in crowd formation); in 'copying', however, the copier knows when his response approximates to that of the leader or model (as in learning a new language). All three kinds of imitative behaviour conform to the same hierarchical conditions. In other words, they are all expressions of subordination to others, in respect of age, status, skill, or intelligence.

The experimental results illustrate various ways in which imitation generalizes. Thus if subjects are rewarded for copying one leader and not another, they will learn to imitate the first and not the second. Imitation spreads from one leader to another similar one, from one situation to a similar one, and from one motivation to another. This is a different way of saying that the prestige of leaders generalizes to other leaders, or to other situations or motivations. None of these results is startling, but all are in accord with common sense. The cumulative evidence indicates that imitation is learned and is controlled by the social conditions which reward it.

The chapters with the most compelling interest at the present time are those on crowd behaviour and lynching. By explaining these in terms of learning theory, they are integrated within experimental psychology. This applies to the effects of all the known factors influencing crowd-behaviour, including inter-stimulation, proximity, numbers, anonymity, prestige of leaders, repetition of stimuli, 'vicious-circular' reactions, emotionality, and uncriticalness. Nearly all these are exemplified in lynching.

The analysis of a lynching helps us to understand one of the pressing problems of to-day, namely, human potentialities for organized brutality on a mass scale. We have seen from the disclosures of the concentration camps that despite deeply rooted humane traditions, a considerable number of individuals who are not psychopaths can 'learn' to execute a programme of sadism with a callousness which challenges belief. In lynching we have a comparable phenomenon, though it is of brief duration and produced in conditions of mass excitement. Thousands of peaceful, law-abiding villagers behave collectively in a way which individually they would abhor. The striking feature which emerges from both 'horror' camps and lynching is this: variation in *potential* brutality is much narrower than in *actual* brutality. Beneath the skin we are much more alike than we appear to be on the surface. Moreover, beneath the smooth civilized exterior the primitive energies are still untamed. Thus it is easier for imitation to be learned and to spread rapidly in undisciplined emotional behaviour. Imitation reduces individuality of response and increases uniformity. If we are to have a stable and humane order, we must look to the 'models of prestige' which evoke widespread imitation.

This is not an easy book to read, and not simply because it makes severe demands on the reader's capacity to follow a series of intricate discussions. Often one has to read a paragraph several times, only to be rewarded by what seems to be a commonplace. It was the authors' professed aim to make their exposition at once rigorous and informative to the non-specialist. If they have discharged the first part of their task with distinction, they have not succeeded so well in the second part. It is to be regretted that with the exception of the last two or three chapters the style of the book will limit its appeal to the specialist.

JOHN COHEN.

IN SEARCH OF RIGOUR

The Foundation of Phenomenology

Edmund Husserl and the Quest for a Rigorous Science of Philosophy. By Prof. Marvin Farber. Pp. xi+585. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1943.) 33*s*. 6*d*. net.

FROM the University of Buffalo there is beginning to flow, as from a watershed, a determined stream of philosophical enterprise, likely, given time and circumstance, to gather momentum as it goes. Prof. Marvin Farber, in this book, the latest venture of the School of Philosophy and Phenomenological Research, has put scholars everywhere in his debt for a labour of love—for and on behalf of Edmund Husserl—difficult to value too highly. It should be said at once that the author is not prepared to accept all Husserl's doctrines without reserve, nor is the nexus of students with whom he is associated ready (as he wrote to me recently) to set up a patron saint in advance to preside over their deliberations. The position is in fact wholesomely fluid. Further, there is no attempt to erect German philosophy in general upon a pedestal: on the contrary, it is found to be unsatisfactory in a variety of ways. This may be due in part to a strife of schools, all too common in Europe, but luckily seldom encountered in the United States. All that is asked is that no hasty judgments should be passed upon such a complex theme as Husserl's pattern of thought. Indeed, to be irresponsible here would be more than ungracious.

So much for the background. We are now invited to contemplate Husserl as 'historically conditioned' the founder of a scientific outlook akin to a *philosophia perennis*, albeit at the same time pliable enough for progress. Additionally, he appears with all the fire and zeal of the Hebrew prophets, in sure and certain hope that his radicalism is well founded, his mission o mankind essential. In this he resembles our own McTaggart, who used to say that the study of philoophy is the most urgent task for every thinking person to tackle, for without it our deepest cravings remain unsatisfied.

In a work so erudite as that now under review, it is agreeable to be allowed occasional glimpses of the personalities of Husserl and of those chosen few to whom was given some measure of his friendship. As a help to the reader's understanding, too, these ntimacies are valuable, and are not to be taken nerely as light touches. For example, the wordportrait of Brentano, at once sacerdotal and learned, brings vividly before one the deep impression that his lectures must have made upon Husserl, and how he determined to forsake mathematics forthwith (in spite of having worked with Weierstrass) in quest of a truly rigorous philosophy.

Much of the text is of necessity devoted to critical surveys of such monumental works as the "Philosophy of Arithmetic", "Prolegomena to Pure Logic", and "Logical Investigations". Of these it is scarcely profitable to attempt an analysis here; preferable perhaps to select a few outstanding features of Husserl's work as a whole, and to discern his purpose. One such characteristic is his ability to make or discover distinctions. It is a major concern of the phenomenologist. Physically, it is akin to using an optical instrument of increased resolution rather than one of extreme magnification. The master's Freiburg period demonstrated this, when someone at his lectures remarked that to sit under him was to find 'new eyes' in philosophy. As a corollary, a warning hand is laid upon the artificial simplicity, so beloved of the superficial and the slick. Complexity rather than the reverse is to be expected: yet a foundation of experience is seldom lacking.

Again, Husserl seems to hark back to his earlier mathematical substratum in stressing the power of the conception of invariants. This now means much more than a method of dealing with transformations; it connotes the 'necessary general form' of all constructive thinking.

Of all the ways which Husserl follows in order to distil his purest thought, perhaps the most remarkable is the establishment of the *epoché* (ἐποχή). He proposes this in place of the universal doubt of Descartes. Thus the world is eliminated (*ausgeschaltet*); which done, transcendental consciousness remains as the phenomenological residuum. The act of so-called 'bracketing' is probably not exactly what the English mind is intended to understand by it. Rather we might think of such judgments as 'waived', since by this term is suggested the possibility of switching in again when the particular need for the process is over. Husserl would probably never have gone so far as to suggest that his eliminated quantities were entirely beyond recovery.

Time and again we find the philosopher in the evening of life returning to the fray, clarifying and deepening his message, yet never doubting that his system contained within itself the essentials of a pre-suppositionless structure, unrelenting in radicalism and veneration for rigour.

Husserl was not to escape some of the barbarities of the Third Reich. Declassed and ignored, he was nevertheless able to write "I prove *sub specie æterni* my right to live". F. Ian G. Rawlins.

COMPARISON OF ENZYME AND IMMUNE REACTIONS

Immuno-Catalysis

By Prof. M. G. Sevag. Pp. xv+272. (Springfield, Ill., and Baltimore, Md.: Charles C. Thomas; London: Baillière, Tindall and Cox, 1945.) 4.50 dollars.

NEAR the end of the nineteenth century, Ehrlich first directed attention to the similarity between enzyme and immune reactions on the basis of their highly specific character. "Immuno-Catalysis" examines this similarity in the light of modern work, and, further, puts forward a detailed case to support the view that the formation of a specific antibody in response to the introduction of a given antigen fulfils all the criteria of enzyme-catalysed systems, suggesting that antigen (catalyst) merely directs the formation from serum globulin (substrate) of antibody (product), which in the immune reaction acts as a specific enzyme inhibitor.

The work is divided into five parts entitled: Part 1, antigens as biocatalysts; part 2, antibody as a specific enzyme inhibitor; part 3, anti-enzyme immunity; part 4, immunity against bacterial enzymes; part 5, the problem of antibody formation against respiratory enzymes. Part 1, in attempting to decide upon the mechanism of antibody formation, necessarily deals with the chemical and physical properties of antibodies and their relation to the serum globulins, with the different theories of antibody formation, and makes some mention of the problem of serological specificity. It is shown that the available evidence favours the idea of the enzymatic action of antigen in stimulating antibody formation.

Part II is concerned, in detail, with the factor of specificity in immune and enzyme reactions, discussing the well-known work of Landsteiner, Avery and others using modified antigens, and with the analogy between enzyme inhibition and antigen-antibody association. Although Parts 1 and 2 contain a strong case for the antigen-catalysed formation of antibody and for the inhibitory action of antibody in the immune reaction, I feel that the case could in parts have been improved by the omission of some of the elementary material, for example, Section B of Part 1 dealing with simple types of chemical reaction, and by a more expanded treatment of the lesser known aspects of immunity, such as anti-antibodies.

Part 3 deals in detail with the question of anti-enzyme immunity, discussing the objections to the existence of anti-enzymes and the importance of non-specific adsorption of proteins, as well as the effect of pH change on enzyme – anti-enzyme combinations. The remainder of this part, and also Parts 4 and 5, form a collection of experimental data on the formation of antibodies and immunity against different enzyme systems. Although the critical analysis and presentation of all relevant experimental data is essential in establishing the nature of antibody formation and reactions, it is felt that this part of the work might well have been separated as an appendix from the main arguments which occur in the first half of the book.

The book is well supplied with references, has a good index (index and references occupying more than forty pages), and is well produced. It should be useful to specialists and non-specialists alike.

P. Johnson.

THE IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

THE Imperial College of Science and Technology came into existence as the result of the federation of three colleges already established in South Kensington, namely, the Royal College of Science, the Royal School of Mines and the Central Technical College of the City and Guilds of London Institute. One of these, the Royal College of Science, and in particular its Chemistry Department, may be said to have originated in the Royal College of Chemistry which was opened in George Street, near Oxford Street, in October 1845 (see p. 524). Thus although the Imperial College of Science and Technology was not incorporated by royal charter until 1907, this year is appropriately regarded as the centenary of the College, and it was marked by a great gathering in the Albert Hall on October 26, attended by their Majesties the King and Queen, the Chancellor of the University of London (the Earl of Athlone), and the Vice-Chancellor (Prof. D. Hughes Parry).

Lord Rayleigh, chairman of the governing body of the Imperial College, surveyed briefly some of the activities of the College; his full address is printed elsewhere in this issue (p. 520). His Majesty the King, whose words were broadcast by the B.B.C., then spoke:

THE Queen and I have listened with special interest to the account which Lord Rayleigh has given of some aspects of the work of the Imperial College since its foundation. His position as a former professor and as chairman of the governing body qualify him to speak of this subject.

We have heard something of the way in which the College has carried out the intentions of those who shaped it. I speak now as its Visitor, and as its Visitor I recall the interest taken by my family, not only in the Imperial College since its foundation in the reign of King Edward VII, but in its three constituent colleges ever since the first beginnings which we celebrate this evening. The Royal College of Chemistry, at its inception in 1845, had as its president my great-grandfather, Prince Albert. He showed the same concern for the well-being of de la Beche's School of Mines, and as president of the Royal Commissioners for the Exhibition of 1851 he gained for science and the arts that great site on which, with other institutions, the Imperial College now stands.

It is, I think, now generally accepted that the idea of the great International Exhibition of 1851 was started by the Prince Consort personally, and that he took a large share in carrying it out. At the time, it had to face serious opposition in the Press, and while a Royal Commission took formal responsibility, the industrialists hung back and did not give the necessary support. The Prime Minister, Lord John Russell, had anxious consultations with his colleagues, and as a result it was arranged that Dr. Lyon Playfair should become a 'special commissioner'. The Prince had some slight acquaintance with Playfair and, before appointing him, means were found to improve it. Eventually the Exhibition was a financial success, and left a large surplus in the hands of the Commissioners, which they spent (mainly at the instance of the Prince and Dr. Playfair) in purchasing the South Kensington site.

Lyon Playfair, the Queen bids me remind you, bore the name of her family, with which he was connected through his mother, Margaret Lyon: and indeed his school holidays had been largely spent in the manse at the Queen's old home, Glamis Castle. As Lord Rayleigh remarked in passing, he heads the distinguished list of your professors of chemistry, having held that position in the Government School of Mines, prior to its incorporation with the Royal College of Chemistry.

But while it is interesting thus to recall the past, my own concern as your Visitor is with the Imperial College of to-day, and as your Visitor I take pleasure in the contributions it has made to total victory. Lord Rayleigh has touched on some in the fields of applied entomology and preventive medicine, and I am well aware that he could—had time allowed—have pointed to equally impressive victories won by your other departments in other fields. I know that the success of our D-day invasion was in great part due to engineers trained in your City and Guilds College, and I know, moreover, that Imperial College has contributed to victory not only by research but by its training of men who go from it to all parts of my Empire. Thus we have heard much, lately, of uranium; for rare materials such as this, no less than for commoner sources of power like coal and oil, the search goes on unceasingly throughout vast areas, and many of those who carry it out have received their training in the Royal School of Mines.

Justifiably we take pride in the achievements of British science and technology during these last years of total war. But with that pride is mingled apprehension, as we reflect on the ever-increasing power that science is giving to a world so prone to use power for evil ends. The atomic bomb, especially, gives food for sombre thinking: it greatly reduced the tol of human lives in the war now ended, but dare we hope that this new discovery will henceforth be controlled for the general weal? I say to you students here assembled—men and women who will soon be going out from Imperial College to your work in the world—on you and others of your generation rests a burden of responsibility greater than men of science have known before; not only to apply your knowledge and training to the service of mankind (that has been done, and well done, by generations that have preceded you), but so to act in the light of that knowledge and training that science may not again be used to destroy.

DR. R. V. SOUTHWELL, rector of the Imperial College, made the following reply:

It falls to me to render to Your Majesty—speaking both for staff and students—most hearty thanks that you, our Visitor, have been pleased to grace this celebration with your royal presence. That Her Majesty has been pleased to accompany you completes our happiness—and gives, perhaps, especial gratification to women members of a college in which, though at all times outnumbered, they have never seen themselves as a 'forlorn hope'. Thrice within living memory we have had proof of royal interest in the growth of our constituent colleges: never before have we been favoured with the presence both of our King and Queen.

To deserve that interest and favour has been and will be our aim. Your Majesty has spoken of our history, and of famous men that we delight to praise: though that history is short by English standards, it is a history of which we think we may be proud, and we believe that its last six years—when their story can be told—will not be judged unworthy of the years that have gone before; and because we think our College has contributed not unworthily to victory in war, we are hopeful that in years to come it will further no less worthily the ends of peace. Your Majesty is served with equal loyalty in diverse ways: our best service, as we believe, will be to spend our energies in promoting science and technology by study, teaching and research.

I have not thought it would be your pleasure to hear from me the tangled story of our evolution. Reviews that aim to be exhaustive are apt as well to be exhausting, and I would beg leave now for only one remark. It is a happy feature of that story that it starts from an act of Your Majesty's great-grandfather; its second chapter now begins with this mark of Your Majesty's favour. It was the Prince Consort who in 1845 presided over the council of that College of Chemistry from which, by a line occasionally devious, the Imperial College traces its descent; it was by his personal intervention that von Hofmann was secured to be its first professor; and it was he who in 1846 laid the first stone of its new building in Oxford Street: a stone that lies here, waiting to be again embodied in our chemistry buildings. It was his unsparing effort that ensured success for the Exhibition of 1851, and thereby the means of realizing his own far-sighted vision of a great metropolitan centre for the promotion of the sciences and arts. No college owes more to its founder than ours to him.

Had his wide views been general, our problems now would be less hard; for then on his splendid ground-site, buildings would have risen in ordered sequence, and Imperial College, chartered in 1907, would have been a federation of colleges that not only were adjacent in the fields of science but lay within the same London borough. As has turned out, though two have buildings that adjoin to form a well-placed whole (and here I would recall that the first stone of each was laid by Your Majesty's grandfather, as Prince of Wales in 1884 and in 1909 as King Edward VII), the third—our Royal College of Science—has its departments scattered widely. It is our hope that not many years will pass before it too has buildings that conform with an ordered plan; but the time has still to come, and as yet we have no place where we may beg Your Majesty to lay this stone, that it may rest from its wanderings. Yet we have craved that some record may remain within our College—to be seen by those that will come after—of Your Majesty's presence with us here; and to that end we have started to prepare a book, to tell of our College's origins, of its evolution in the hundred years now ended, and of what was done to mark this first centenary. It will tell as well of the appeal that we have made in recent months for funds wherewith to foster, in the future, a fuller and more corporate college life; and it will record the names of donors who have responded. We would beg Your Majesty to append your name to this record as our Visitor, so that men of our College may read, in years to come, of the signal favour shown to us this evening: favour for which all we who are here assembled tender to Your Majesties our humble and hearty thanks.

WE print below some tributes to the influence of the Imperial College, which we have received from distinguished senior members of the College:

SIR RICHARD GREGORY, BT., F.R.S., Editor of *Nature*, 1919–39:

When I went to South Kensington in 1886 it was as a 'science teacher in training' at the Normal School of Science, now the Huxley Building of the Royal College of Science. As the original name signifies, the school was a place for the practical training of teachers in elementary science, so that they could conduct courses of instruction in day and evening classes under the Science and Art Department. In physics, the first year's work consisted almost entirely in the making of apparatus, from thermometers to galvanometers, with the necessary linear or angular graduations for measurements with them.

To those of us who intended to become science teachers, this course was admirably suited; for in those days few ready-made physical instruments were available in any schools. Vernon Boys, who was in charge of the physical laboratories, was thus able to impress upon hundreds of students the value of making use of the simplest materials in the art of experimentation, of which he was an acknowledged master throughout his life.

This was also the spirit of the completed course of physics (Parts II and III) which I took with Prof. Boys, while he was producing the extremely fine quartz fibres for use in physical instruments. Its purpose was not so much to load the mind with facts as to stimulate independence in methods of scientific research. While I was taking the advanced course, Prof. (afterwards Sir Arthur) Rücker was appointed to the chair of physics at the College, and it was he who began the developments of the subject to the high university standard in teaching and research for which the College is now world-renowned.

As one of the oldest students of the original Normal School of Science, I welcome this opportunity of paying grateful tribute for what it did to give us sound ideas on scientific methods and meanings. We were justly proud of the school in those days of Victorian science and were given additional honour when it became the Royal College of Science, and later a constituent part of the Imperial College of Science and Technology.

After my student days, my direct association with the teaching of research was as an assistant to Sir Norman Lockyer in the Department of Astronomical

Physics and the Solar Physics Observatory. This determined my whole career, for in 1893 I became Sir Norman's assistant on the staff of *Nature* and succeeded him as Editor in 1919. With these early recollections in mind, and knowing the high scientific standing of the members of the staff of the Imperial College since my days, it would be almost a presumption for me to add my testimony to its greatness. I shall, however, always cherish in my heart the influence the College has had on my life, and entertain with pride the feeling that I once played a minor part in the work of a branch of this great centre of scientific learning and research.

Dr. W. H. Eccles, F.R.S., formerly professor of applied physics and electrical engineering, City and Guilds of London Technical College:

In the closing years of the nineteenth century, when I was admitted to the Royal College of Science, I found it a well-established and bustling community. Nearly all my fellow-students seemed to be remarkably mature and responsible beings who had already had experience in science-teaching, in works or in laboratories. They, rather than the staff, created the atmosphere of the College, which might be described as one of altruistic utilitarianism; many of them were reading science in order to assist industrial progress, each in his original walk of life. Moreover, the wise men who had made the College syllabuses had fostered this atmosphere in advance by ensuring that the instruction should be on a Baconian not a Platonic basis.

Active discussion with one's fellow-students showed that this strong orientation toward usefulness intensified the desire to read 'pure' science, a desire which merely gave expression to the spreading opinion that the important changes in industry would henceforth come from accurate measurement and the scientific method rather than from the method of the craftsman, and that new processes and even new industries could spring only from new scientific discoveries. Men like Armstrong, Judd, Huxley and Magnus had been preaching this doctrine for some twenty years, and had aided in setting up at South Kensington not only the Royal College of Science, but also the School of Mines and the Central Technical College of the City and Guilds of London Institute, all of which are now components of the Imperial College.

The gratitude I feel for my five years of opportunity at the Royal College of Science (plus occasional lectures at the Central) is deepened by the assessment I obtained there of the functions of science in the modern world. A new and broader meaning was given to the word 'technology' which, according to the dictionary, is the 'science of the industrial arts', but which now appeared to be 'science *for* the industrial arts, existing and to come'. If only there had been at the Royal College of Science research courses in the application of modern science to problems in nascent industries, I should have departed even more indebted to the College; as it was, I became one of Marconi's assistants and was launched on the practical world in that way.

Looking back at the careers of my contemporaries at the College, I find that nearly all of them took up the task of introducing science, in one way or another, into industrial affairs; I know of many who have done much for industry. May the modern Imperial College be increasingly successful in moulding such pioneers.

Sir William Jarratt, formerly Comptroller-General of Patents, Designs and Trade Marks:

It is an appreciated privilege to be allowed to join the chorus of congratulations on the Imperial College centenary celebrations. During the years 1887–90, when I was a student at the College, the changes that were occurring included the amendment of the name and status of the Normal School of Science to the Royal College of Science, and I well remember my delight that my leaving certificate was signed by that great controversialist Huxley, the dean of the School and College, and by the founder and first editor of *Nature*, Sir Norman Lockyer, better known to readers of *Punch* as 'Noman Luckier'.

In those years research posts, either in industry or at universities, were not plentiful, and in consequence many students became science masters or took posts in the Civil Service such as Patent Office examinerships. With Government encouragement, however, the importance of research became increasingly recognized, and more students availed themselves of the opportunities to follow up scientific research. It is a matter for congratulation that during this development the College authorities have never ceased to recognize that side by side with scientific research, long-term or otherwise, the industrial development and the social conditions of Britain necessitate the application of the results of research, and that this industrial application is stimulated by a strong patent law such as we fortunately possess. The best results from scientific research can scarcely accrue to the State without some such form of guarantee to those enterprising industrialists who take financial risks in applying to industry the results of research.

As the years have passed it has been a pleasure to watch the steady development of the College and its increasing influence among the forces that have retained for Great Britain its position in the forefront of scientific progress. I desire to congratulate heartily the College authorities on their magnificent record.

CONTRIBUTIONS OF THE IMPERIAL COLLEGE TO THE CONQUEST OF DISEASE*

By the Right Hon. Lord RAYLEIGH, F.R.S.

On an occasion like this it is natural to take stock of the work we and our predecessors have been able to accomplish since the first beginnings of the College a hundred years ago. But this work covers so wide a range, and so many different specialities in all branches, from physics and engineering on one side to zoology on the other, that in the course of a short address one cannot even glance at all aspects of it. Looking for some fairly comprehensive topic to which a good many of our departments had contributed, I was struck by the victories which had been won over the agencies of disease. It might appear at first sight that this was a matter of medical science, with the obvious comment that none of our departments deals with that subject. Important though the medical applications are, these investigations have been developed rather from the point of view of physics and chemistry. But there is no need to emphasize professional aspects of this kind.

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* Introductory address for the Centenary Celebrations on October 25.

These problems are so vital to all of us that we must use any and every method to solve them, and accept help from any quarter. The civil engineer would at one time have said that entomology had nothing to do with him. Nevertheless, he was defeated in the attempt to make the Panama Canal until he had accepted the help of the entomologist in dealing with yellow fever, and the mosquitoes that transmit it.

Our efforts have recently been concentrated on overcoming our human enemies. Formidable though these have been, there is another class of enemies whose methods are very different, but whose fundamental purpose is for the most part the same, namely, to promote their own well-being at the expense of ours. They are to be found among certain of the lower forms of life, the microbes, which are primarily responsible for fevers and infection, and the insect bearers of disease, which play an equally important if not quite so insidious a part in conveying the microbes to the scene of action. It is only in modern times that these enemies have been recognized as such: and even now many people talk glibly about microbes with little or no understanding of how we have learnt that they are of the essence of disease, that they are in the food we eat, the water that we drink, and the air we breathe. Not only are the lower forms of life constantly lying in wait to attack life and health, but they are also formidable competitors for our food supply, and can rarely be altogether prevented from taking their toll of it.

The late Sir Alfred Keogh, director and reorganizer of the Army Medical Service, and afterwards rector of the Imperial College, told me an incident which may serve to illustrate this. The scene was the Army Council, of which he was, of course, the only medical member. He urged the introduction of certain hygienic measures, explaining briefly the reasons for them. Not much was said by his more purely military colleagues, but one of them, a general who had distinguished himself greatly in the South African War, came up to him afterwards and said: "I was very glad to support you in what you wanted done; but, tell me as man to man, do you really believe in microbes?" Keogh, rather at a loss for words, could only insist on his coming to see them for himself.

I will now try to sketch in outline how this belief gradually forced itself on the scientific world, illustrating the story as far as possible by the investigations made in the Imperial College.

It had become widely recognized that the spread and multiplication of fever cases had many points of resemblance to the spread and multiplication of living beings. Thus each species of plants or animals multiplied according to its own kind; and fever cases did the same. Smallpox gave rise to smallpox and to nothing else; typhoid fever gave rise to typhoid fever and to nothing else. The infection starting from a single case could give rise to an unlimited number of others, and putrefaction was one single phenomenon, whether it occurred in the wounds of the living, or in dead bodies of men or animals.

On the other hand, observation seemed to show that exposure to the air was the essential condition for putrefaction. For meat broth, boiled to expel air and sealed up in glass flasks, would remain clear and free from putrefaction for an indefinite period. If the sealed flask was opened to admit air, putrefaction quickly set in. The same thing is now familiar to everyone in cans of tinned meat. This remains good indefinitely until it is opened and the air is admitted. These contrasting facts appeared to Tyndall's generation very contradictory. There appeared to be no doubt that putrefying animal matter was swarming with life, for it could be observed under the microscope that this was the case; and since there was no obvious source for this life to have come from, many were of opinion that it must have been generated in the putrefying matter. This question was, in fact, whether there was spontaneous generation of life or not. No question could be of greater importance. It was urged by some that since life existed on the earth, it must have come into existence since the earth was formed; and if this had happened once, it was reasonable and in accordance with the scientific habit of mind to assume that it would happen again in similar circumstances: and they thought it obviously did happen under observation when meat became putrid. Tyndall, however, was not satisfied by this reasoning; and I will try to give an account of his contribution to the subject.

In his researches on radiant heat, and in his experimental lectures at the Royal Institution and at this College, he had been in the habit of making use of the electric arc to throw out a concentrated beam of light, and he observed how the track of the beam could be traced by the way in which it illuminated the dust particles in the air. Most of us are now pretty familiar with this, because of the searchlights used in war. It was not so commonplace then, and I may recall that the only source of current for the electric arc, or at any rate, the source in general use, was a primary battery of forty or fifty Grove cells, very tedious and troublesome to set up and maintain. Tyndall tried whether he could not get rid of the dust in air. He found this difficult at first, but ultimately succeeded by filtering the air through tightly packed cotton-wool. When he did this, he found that the track of the beam became invisible, and the air through which it passed was, as he expressed it, optically empty.

He prepared specimens of broth from various kinds of meat and fish, and boiled them in order to kill any living matter they might contain. Then he found that such broths would putrefy when they were exposed to ordinary air, but not when they were exposed to air which had been freed from dust, and which showed no motes in a concentrated beam of light. Ordinary air caused putrefaction. Dust-free air did not. These simple tests went far to resolve a great and fundamental question. The putrid broth which had been exposed to the open air was soon found to be swarming with living matter, visible as such under the microscope. Where did it come from in the first instance? Was it generated in the liquid? That was the opinion of one prominent school of thought; but Tyndall's experiment showed that if all living matter was killed by boiling, exposure to the air would not generate any more. Life only comes from life, and however much appearances may at first sight suggest the contrary, it is not generated anew under our eyes.

Tyndall's researches ran to a great extent parallel with the famous investigations of Pasteur, with whom he was in touch. Without prejudice to workers elsewhere, we on the present occasion naturally dwell on the contribution of our professor, made by a method entirely his own, which led him to important discoveries in other directions also; for example, the artificial imitation of the blue sky, and its optical peculiarities—far enough, one might think, from problems of infection, disease and the origin of life.

Bacteria are not only very small, but also they are colourless, and it is only after they have been stained that it becomes reasonably easy to investigate or even see them. It is found that one class of bacteria will take up one class of stain, exemplified by methyl violet, and other bacteria will take up a different class of stain, exemplified by fuchsin, which is red. The reason for this is somewhat obscure, but whatever the reason, the fact is very helpful in distinguishing between the various bacteria. I have entered on this subject because I wished to recall that the aniline dyes used for this purpose, and also for such minor purposes as colouring our clothes, carpets, curtains, cushions, had their origin in this College in 1856, when W. H. Perkin discovered mauve. He was not a professor, but a student under Hofmann, and was only eighteen years old. He immediately took the matter up commercially, though Hofmann did not encourage this, and Perkin himself had never even been inside a chemical factory before. It sounds like a fairy tale, but he made a fortune out of it, and retired to pursue his studies in pure science.

I have mentioned methyl violet and fuchsin. These were among the discoveries of A. W. Hofmann, who succeeded Playfair as professor and by whom Perkin was trained. It may be a little confusing to be told that the first aniline dye was discovered by the youthful pupil and the later ones by the professor, but so it was.

The famous name of Hofmann, who was brought here by the personal influence of the Prince Consort, leads to another aspect of our main topic. Much anxiety had been caused in the early sixties of the last century by the questions of the purity of water supply and of the disposal of sewage. Pure water in great cities is now almost taken for granted. This has not always been so. When Catherine of Aragon came to England as a bride, she was warned not to drink water in England as it was not fit to drink, and as regards the low-lying land of the southern counties this was doubtless quite true. Coming to a much later period, I can remember, probably about 1885, when I made as if to help myself to a glass of water in the waiting room at Liverpool Street Station, that I was warned never to drink water in such places! The warning may have been somewhat out of date, but not by much, for surface wells were still in use in some parts of central London as late as 1867, when the water from them was found on analysis to be disgustingly polluted, and quite unfit for human consumption.

Hofmann first gave attention to the subject of water analysis at the same time that he was at work on the aniline dyes, but he had scarcely got his teeth into the problem before he left Britain for good and was succeeded in his professorship at the College by Sir Edward Frankland, who took up the question with great vigour, and examined anew for himself the various methods of analysis which had been in use, with the result that he found that on some of them, at least, little reliance could be placed.

I ought to explain more clearly what is meant by water analysis in this connexion. We are not, of course, speaking of mineral or medicinal water but merely of drinking water; and the vital question is, Has it been contaminated by contact with foul matter? Very little definite was known about micro-organisms at that time. But Frankland already considered it more than probable from the history of past outbreaks of typhoid fever in various places that the infection could be carried by drinking water, and that a specific poison associated with this disease must exist. For bad though the position was, it was only exceptional specimens of foul water that gave typhoid fever, so that foulness was not enough by itself. No one, however, knew at that time what this agent was, or how to test for its presence; and indeed, we have no very practicable direct test of this kind even now, though we understand a great deal more about what the source of mischief is and how to guard against it.

In the absence of a direct and easy test as to whether the water is actually infected, we have to fall back on indirect tests as to whether it has been exposed to contamination, and these are found in seeing how far the water contains ammonia and nitrates. These substances are harmless enough in themselves, but they contain nitrogen, and as Frankland proved in detail, it is usually pretty certain that they got their nitrogen from highly undesirable sources. So an analysis for these tells us a great deal as to whether the water can be trusted.

Having established these and other methods, he put them extensively into practice, and examined the water in London and in various parts of England. The result was broadly to confirm that there was a very great difference between surface water from the Thames and Lee Valley for example, and that from deep wells sunk in the chalk or the greensand. The test of analysis on the lines explained showed that the shallow-well water in the Thames Valley, though it might look and taste quite good, was really little better than filtered sewage.

The idea prevails rather widely that we can readily decide whether a sample of drinking water is safe by looking for the presence of typhoid bacilli. Unfortunately, to look for the typhoid bacillus in drinking water is like looking for a needle in a haystack. It might succeed in the case of extreme contamination, but it is not easy enough or certain enough to be a practical procedure. Bacteriological examination is of the greatest value, but like the chemical methods it only leads to general conclusions, and by no means supersedes those methods.

The development of our knowledge of bacteria is by far the greatest contribution ever made to the study and prevention of disease; for it has given us not only the modern mastery of infectious diseases, but also has made possible the great advances in surgery. I have tried to bring home to you that our College has had its fair share in their development. But we must now turn to another subject, kindred to this one, and of comparable importance. That is the control of insect pests.

Man flatters himself that he is the 'Lord of Creation'; but the insects do not show themselves impressed with this point of view, and usually go on their own way, hostile to man, and treating his pretensions with very little respect. It has always been known that some species, such as the scorpion and the tarantula spider, might on occasion be dangerous but it is only in comparatively recent times that we have understood how many and how formidable are our enemies in the insect world.

The man of science feels intuitively that definite facts about Nature always have their value, but he does not always find it easy to convince the man in the street of this. If there was any branch of science where it appeared difficult, it was perhaps in entomology. The insect pests are our enemies in innumerable ways. We have only just begun serious warfare against them, and the successes which have been won in the last few decades are but a fraction of those that may fairly be expected in the decades to come; moreover, our victories over them have a permanence and finality that cannot be hoped for in victories over human enemies. The great strength of our insect enemies has been that for long we did not understand that they were our enemies at all. That lesson once learnt is not likely ever to be forgotten while our civilization endures. But it was not learnt easily. The critics who make merry at the expense of scientific pursuits have seldom been more confident or more utterly wrong than in this instance. For example, Thomas Shadwell, a well-known playwright, published in 1676 a play called "The Virtuoso", in which he satirized the naturalist of the day as Sir Nicholas Gimcrack, whom he described as follows: "A coxcomb, he has studied these twenty years about the nature of lice, spiders, and insects . . . no man upon the face of the earth is so well seen in the nature of ants, flies, humble bees, earwigs, hoglice, maggots, mites in cheese, tadpoles, newts, spiders, and all the products of the sun by equivocal generation. This foolish virtuoso does not consider that one bricklayer is worth forty philosophers".

We know now that malaria is transmitted by anopheline mosquitoes, dysentery by the common house-fly, typhus by the louse and plague by fleas. The case of mosquitoes and malaria is of special interest, because it is not just any mosquito but the particular species of anopheles which is recognizable by 'walking on its head'. The recognition of facts like these is in the process of conquering the tropics for civilization, and I think we may fairly claim that it has been proved that if anyone is a 'coxcomb' it is not the naturalists who concern themselves with these insects, but the critics who affect to despise them for doing so. I do not say this in any spirit of self-complacency, having myself, many years ago, been unsympathetic to a friend who concerned himself with the close study of fleas infecting various animal species.

In view of facts like those I have mentioned, the Zoology Department of the College under Prof. J. W. Munro has, of recent years, paid special attention to the subject of economic entomology, and has built up a large body of knowledge about insect pests and how to combat them; and when the War came its staff and resources have been used to the full in protecting stocks of grain from insects and rats, and in combating the mosquitoes, flies, and other even less pleasant insects which infect our troops with malaria, yellow fever, sleeping sickness, typhus and plague.

Typhus, there is good reason to believe, killed more people than all the weapons of war during 1914–18. We can scarcely say as yet whether a similar statement would hold for the present War; but most people find it difficult to realize the true bearing of facts of this kind. Many, it may be suspected, picture the horrors of war mainly in terms of bayonet charges and the like, as in the pictures of Napoleon's campaigns; and, indeed, these are arresting enough: but they only show a minor aspect of the terrible reality. The louse, we now know, is far more deadly than the bayonet.

The successful attack on insect pests has, however, depended to a great extent on the possession of a suitable insecticide to use against them. Supplies of pyrethrum were largely cut off by the entry of Japan into the War, and attention was turned to a new insecticide, D.D.T. Neither this substance itself nor the application as an insecticide is entirely new, but its value has been explored much more fully than before, and it has been used on an unprecedented scale. It is practically without smell, and is very persistent. Thus, when sprayed on walls at a suitable concentration it kills any fly alighting on them up to a period of three weeks. A bed sprayed with it is fatal to bed bugs for three hundred days, and clothing dusted with it is safe from lice for a month, even after several launderings. Impressive though these results are, it is not claimed that D.D.T. is a final solution of all insecticide problems or that it puts all other insecticides out of court.

As we have seen, the insect pests in many cases convey dangerous or deadly infection by their bite, and as we have seen, much is being done to cut off the sources of infection as well as to destroy its insect conveyors. It cannot, however, be claimed that full success has yet been attained in either direction, supposing that the invader has got past our defences, and has effected a lodgment in the human body. Can we still hope to attack him? Obviously this is a much more difficult matter, and for long it appeared almost hopeless. We can attack micro-organisms or insect enemies with all sorts of more or less poisonous disinfectants such as carbolic acid or D.D.T. when they are outside the human body, but when they have effected a lodgment inside it their position becomes far stronger; for we cannot in general attack the enemy without endangering the friend in whose body he has ensconced himself. You see, then, how difficult the problem is. Light has come from the recent development of penicillin, which while harmless to the patient is poisonous to the invading micro-organisms. Penicillin is the product of a plant mould, and the romantic circumstance is that nearly all the penicillin in use, which is saving lives and relieving anxious hearts all over the world, is the progeny of the single small spot of penicillin mould originally observed by Sir Alexander Fleming. The preparation of concentrated penicillin from it is a matter of no small technical difficulty, and with this and the question of its chemical nature our Organic Chemistry Department under Prof. I. M. Heilbron is vigorously occupied. But our hopes go much further than this. Penicillin is obtained at present from the natural plant source, just as, for example, indigo and a host of other economic products were obtained from plant sources. There is, of course, the difference that indigo is grown in the fields, while penicillin is grown in bottles. But indigo is now made in the chemical factory instead of being obtained from the plant, and the hope is that penicillin may also be produced synthetically, and much more easily and cheaply than now.

Before we try to build up the structure of the penicillin molecule we must, in the first place, have an accurate knowledge of its ultimate composition. That is to say, we must know what kind of atoms, and how many of each, go to build up the structure. That step has now been achieved, but it is by no means enough in itself. To picture what a house is like it is not enough to know what quantities of bricks, slates, timber and so on have been used in building it. You must know how they are arranged. You want an architect's plan. That is what we are trying to make for the penicillin molecule. When the elucidation of the plan of the penicillin molecule made by Nature in the plant has been completed, it will in all probability be possible to build up the same structure in the laboratory by the methods of synthetic chemistry, and even to go further by modifying the structure so as to extend its applicability.

THE ROYAL COLLEGE OF CHEMISTRY

By Dr. E. FRANKLAND ARMSTRONG, F.R.S.

THE centenary of the founding of the Royal College of Chemistry in October 1845 is an occasion on which we may well take stock of its influence on the progress of pure and applied chemistry in Britain.

The story of the hundred years is a story of men and not of laboratories—of professors and disciples, of enthusiasm and of hard work for its own sake. Laboratories are never large enough or sufficiently equipped—perhaps in Britain they never will be—but the great man rises superior to his physical surroundings or handicaps and the student is surely all the better fitted to face the future when not pampered. Latent powers are best evoked by sufficient severity of circumstances, as the long history of our race bears abundant testimony.

In the 1840's things were changing; a nation of countrymen was slowly turning into a nation of townsmen. It was an age of movement, of traffic on canals faster than the coaches on the roads, and on steam railways faster still. It was an age of wheels, wheels at the pit head, spindles in the cotton and woollen mills. The pace of life was quickening on every side.

In 1842 all England was agog: that great man Baron von Liebig was on tour in the industrial Midlands and North. The tour was personally conducted by none other than Lyon Playfair, who took care that Liebig should meet the most influential people and impress on them the national importance of the new science of experimental chemistry. Such a triumphal tour made its influence felt in all the chief centres of Great Britain. At the end of his visit, Liebig is reported to have said "England is not the land of Science"; a hundred years later there is still very much to be done before we can claim to be entirely free from this reproach.

Liebig's tour helped to direct attention to chemistry and make it a popular science, for it must be remembered that at this time it was very seldom that any students desired to become chemists. The Pharmaceutical Society claims that the first laboratory open to students was one under its auspices with Fownes as teacher. This would be in the early '40's, and he was the author of a text-book "Fownes' Chemistry". Jacob Bell, the then president, would have made the pharmacy into an *Apotheke*—not a druggist or a fancy goods store—had he been listened to. There were already courses at University College and King's College, London, in which chemistry was taught as part of the training for other professions. The promoters of the Royal College of Chemistry sought, however, to do something new by founding an institute in which chemistry would be studied for its own sake apart from professional requirements. It was anticipated that the students who came there would make chemistry the occupation of their lives and enlarge its boundaries by research in the laboratory.

The first effort of the enthusiasts, inspired by Liebig's visit, was to attempt to found a Davy College of Practical Chemistry within the Royal Institution. This effort did not succeed, but it led to further meetings and so the Royal College came into being. Two men share the credit for its foundation, Sir James Clark, the Queen's physician, and the Prince Consort. The Prince Consort was at that time president of the Society of Arts, in the affairs of which he took an active part, often presiding at council meetings. His contact there with men of science must have supplemented his personal interest in these matters and he was eager to lead the nation to take science seriously. But a new college of this kind could not have been created unless there had been a strong popular feeling in its favour. All depended now on securing the right leader. The advice of Liebig was sought; Fresenius and Will both refused, Hofmann was dubious about accepting, as failure of the new college would retard his career in Germany. Once again the Prince Consort intervened, and it was thanks to his efforts that Hofmann was given two years leave of absence from Bonn so that he might, if necessary, at once re-enter on his career in Germany. The choice was a happier one than anyone knew. Hofmann became not only the greatest research leader of his day; he evinced many other attributes which contributed to the success of the new enterprise.

Hofmann made a start in the temporary laboratories at George Street, Hanover Square, in October 1845. A year later it was possible to commence work in the new building in Oxford Street backing on Hanover Square. There were twenty-six students in the first course, among them E. C. Nicholson, F. A. Abel and, above all, Warren de la Rue, who more than anyone else helped Hofmann. Others were Henry How, Thomas Rowney, C. L. Bloxam, Robert Galloway.

The second batch of students brought thirty-seven more, including C. B. Mansfield and George Merck, F. Field, H. M. Noad, Bransby Cooper and John Blythe. It is to be noted that Hofmann's rising fame soon attracted his own countrymen to his laboratory, particularly as his private assistants, who included Peter Griess, the discoverer of the diazo reaction, and Martius. Other distinguished names of this early period were Crookes, Spiller, Tookey, Reginald Morley, Groves, Ansell, Church, Matthew Johnson, H. M. Witt, H. McLeod, Valentin, Barrett, Bassett, Vacher, O'Sullivan and Reynolds.

From its earliest beginning the duty of the College has been to produce men, leaders in their chosen walk in life. The professors, by their example, precept and teaching, encouraged a progeny keen on enlarging the boundaries of knowledge, able in their turn to teach and inspire a later generation. Science for its own sake, unfettered and unrestricted, must still be the keynote of its activities, even though to-day science has its practical applications to the daily avocations and health of the people and in the development and progress of industry. Unfortunately, the nation at large is barely science conscious, and it will remain indifferent until science, particularly scientific method, is more widely taught in the schools.

In 1851 the Government School of Mines and of Science Applied to the Arts was founded in Jermyn Street, with Playfair as its professor of chemistry. Some confusion exists about Playfair's post, which need not be discussed here. He retired in favour of Hofmann when the two colleges were incorporated in 1853 as the Metropolitan School of Science Applied to Mining and the Arts, which in 1863 had its name changed to the Royal School of Mines. In spite of the official incorporation, the Royal College maintained some measure of independent existence and ontinued to confer its own diploma until it moved to South Kensington in 1872, where it became part of he Normal School of Science in 1881. At the same ime the departments of biology, physics and applied nechanics went there from Jermyn Street. The uilding in which they were all housed became known ater as the Huxley Building.

In the wake of the 1851 Exhibition, and fostered y the newly created Department of Science and Art, a demand spread throughout Britain for instruction in science subjects—given mainly if not almost ntirely in evening classes—among which chemistry vas predominant, physics, botany and geology also ttracting many students. These classes, promoted or recognized by the Department of Science and Art, vere financed largely during many years by payments ased on the success of the students in its examinaions. To meet this demand for more advanced nstruction, yearly a number of selected junior eachers of, and promising students from, recognized lasses received free education and maintenance in he College after its removal to South Kensington in 1872.

In 1881 the name of the college was changed to the Normal School of Science, and in 1890 to the Royal College of Science, to mark enlargement and consolidaion of its scope and functions—among which from ts earliest days was a special reference to the applicaions of chemistry to "the Arts and Manufactures". Its students could be classified under the headings : ee-paying, exhibitioners ; teachers in training Science and Art Department) ; and, between c. 1886 nd 1902, Inland Revenue and Excise (customs) officers taking either the one- or the two-year course in hemistry. The academic year was divided into two nd not three terms and in each term only one subect was studied ; chemistry, with some mathematics, eing taken by all associateship students in their irst term as the initial subject of their course.

Hofmann resigned and went to Berlin in 1865 ; e was succeeded by Edward Frankland. Edward Thorpe succeeded Frankland in 1885 and five years ater the title Royal College of Science was born. William Tilden followed Thorpe in 1894. Frankland eceived the K.C.B. ; Thorpe and Tilden were knighted n recognition of their services to chemistry.

The changes of name of the College are somewhat ewildering. In fact, for some thirty years, during 851–81, there was a conflict of divergent aims and nterests between the party led by Huxley and the cience and Art Department, which wanted a great etropolitan school embracing all branches of applied cience, and the mining school opposition which did ot want to see the development of the Jermyn Street school hampered. It was in reality a conflict ver lack of space, a basic trouble which will always e true of a growing college.

On the foundation so truly laid by the Prince Conort, the edifice built by Hofmann has endured a undred years. Founded in days when chemistry ould scarcely be called a science, no fairy tale can atch the wonders of the progress of chemistry and f the dye industry which it is the proud boast of the ollege to have originated. The torch borne in turn y Hofmann, Frankland, Armstrong, Thorpe, Tilden, app, Wynne, Morgan and so many more still burns s brightly. The laboratories of the Royal College ave sent out into the world men who have given us lean water, dyestuffs, and brought progress to every ranch of pure and applied chemistry. Those who have taught have handed the ideals on to their students, who have in time permeated to every university in the land. A genealogical tree to-day would show few chemists who do not claim descent in some way from Hofmann or one of his three successors.

Although the first discovery of benzene is properly attributed to Faraday, it was Hofmann who, needing aniline, the key substance of the dyestuff industry, for his researches and hampered by the very small yield obtainable from indigo by distillation with alkali, discovered in 1845 how to convert benzene into nitrobenzene and reduce this readily to aniline. To-day we should still regard this as the most important reaction in organic chemistry. Thereupon Mansfield was set to work on benzene in the Oxford Street laboratory, and not only separated it from coal tar and showed how it could be prepared on the large scale, but also emphasized that it could be procured to any extent from this hitherto waste product.

Very soon afterwards, the aniline colour industry came into existence with Perkin's discovery of mauve in 1856, followed soon by an anthracene industry and an azo colour industry. Synthetic dyestuffs had arrived. All these centred around the College of Chemistry—the men who made them possible were Hofmann, Perkin, Griess, Nicholson, Simpson, Maule. Hofmann did his best to raise up an English tree of organic chemical industry, and for a while it grew apace. He was perhaps the first to urge that while capital can do much, capital directed by the lights of science may accomplish much more.

One of Hofmann's talents was his faculty of gauging the powers and special qualifications of those who studied under him. All who worked with him were stirred to enthusiasm, and failure to produce results was a real personal grievance. My father has written that "he made the student his personal instrument —no one has ever been more avaricious of results and he was always carried forward by this desire". Frankland, who succeeded him, had no such tendency ; he had peculiar difficulty in getting behind the students' work and finding out what had been done. Only those could work effectively with Frankland who needed little, if any, guidance. He let his students handle things for themselves and so gain an intuitive understanding of the method of discovery. His manner of lecturing was the very antithesis of Hofmann's, but his lectures were more impressive on account of the wealth of fact and the attention he gave to the experimental side. He was both a pioneer of research and of structural formulæ, and undoubtedly England's greatest chemist of his time.

In 1868 Frankland became a member of the Royal Commission appointed to inquire into the pollution of rivers and the domestic water supply of Great Britain. More than anyone else, he is responsible for giving us pure drinkable water, since he discovered that slow percolation through porous soil effected the oxidation and destruction of organic matter with great rapidity. His most famous pupil was H. E. Armstrong, who went to the College in Oxford Street just as Hofmann was leaving. Armstrong had two years and a term there, the last year or more being spent in the private laboratory working on the revision of the methods of water analysis.

Armstrong left Frankland late in 1867 to work for two and a half years with Kolbe in Leipzig. He has written that the return of a prodigal son from Germany was then a novelty; owing to Hofmann being in London and Liebig no longer an attraction, the habit of studying chemistry in Germany had ceased among English students: it set in again, but only gradually, owing to the enforced emigration of holders of research scholarships awarded by the Royal Commission of the 1851 Exhibition.

Armstrong worked first at the London Institution and then took the leading part in the establishment and development of the Finsbury and Central Colleges. His research school at South Kensington was worthy of the traditions of Hofmann and Frankland, and such men as Wynne, Kipping, Pope, Forster, Lowry, Heller, Rich, Renwick, Rodd and many others developed there. In the main, its students went into the chemical industry, and almost without exception they have distinguished themselves by playing a leading part in their chosen industry and its development.

T. E. Thorpe came to the College as its third professor of general chemistry and technology in 1885 from Leeds. Whereas his predecessors had been essentially organic chemists, Thorpe's interests lay in the inorganic and physical sections of the subject. He was a polished writer and also administrator and publicist. Thorpe had other wide scientific interests, taking part in eclipse expeditions and the magnetic survey of Britain. Some of his scientific work at the College concerned the determination of atomic weights—of silicon with J. W. Young, of gold with A. P. Laurie—while phosphorus compounds were studied with J. W. Rodger, Hambly and Tutton. He left to become the director of the Government Laboratories. Small in stature, he was a man of outstanding virility, and his example quickened the spirit of a band of devoted students and staff. Thorpe came back to the College on Tilden's retirement for three years to tide over the period until the Imperial College had come fully into being.

The Chemistry Department in Thorpe's days was housed in the Huxley Building in one large lecture theatre, two analytical laboratories designated North and South on the third floor, a long corridor-like room on the second floor facing west used for research, and several private rooms. The fittings and equipment, doubtless installed in 1872, were already old-fashioned. It is worth while pointing out how quickly a chemical laboratory grows out of date—a new one is required at least every thirty years. It is perhaps desirable to consider whether palatial and costly solid buildings should be erected for such purposes, or whether more simple structures would not be more practical and economical. They could be rebuilt every ten or fifteen years and kept continually up to date.

In 1894, W. A. Tilden from the Mason College, Birmingham, followed Thorpe. Much of his time was devoted to teaching and administrative duties, including that of dean (1905–8), and his own experimental work, largely concerned at that time with a systematic study of specific heat, was interrupted. His earlier researches had been in organic chemistry, notably the first discovery of the polymerization of isoprene to rubber, work in which M. O. Forster, then his private assistant, had a hand. Tilden's period covered a transference of the Chemistry Department from the Huxley Building to its present domicile in Imperial Institute Road: the design, construction and fitting of the new laboratories involved much of his time.

H. B. Baker succeeded Sir Edward Thorpe as professor of chemistry on the latter's retirement i 1912 and the opportunity was taken to found separat chairs of physical and organic chemistry to whic J. C. Philip and J. F. Thorpe respectively wer appointed in 1913. The Department was thus wel equipped to deal with chemical problems arising ou of the First World War, in the investigation of whic it took no small share. With the return of peace Baker resumed his study of the influence of complet dryness on the physical and chemical properties o solids, liquids and gases. On his retirement in 1932 he was succeeded by H. V. A. Briscoe, a former studen (1906–9) and member of the staff, who came from King's College, Newcastle-upon-Tyne, and on th retirement of J. F. Thorpe in 1940, I. M. Heilbron o the University of Manchester succeeded to the cha of organic chemistry, the chairs of chemistry revertin to two in number after the death of J. C. Philip i 1941.

In the building up of the great school of chemistr at South Kensington, the non-professorial member of the staff had a large share: some gave long an devoted service, while others in due course accepte professorships elsewhere. Only a few names can b mentioned in the space available; those omitted a in no sense forgotten by their students.

F. R. Japp was chosen by Frankland in 1878 t take charge of the Research Laboratory which wa then being established, and to devote his whole tim to the supervision of the research students. In 188 he was promoted assistant professor. Japp ha worked abroad with Kekulé and Anschütz; he spen twelve years in London, where he gathered aroun him a large number of able and enthusiastic student and research was prosecuted with great activity Finally he went to Aberdeen and founded there school of advanced chemical study.

W. P. Wynne succeeded Japp; he had been student at the College during 1881–85, and the joined H. E. Armstrong at the Central, where f many years they were jointly engaged on studies the constitution of naphthalene derivatives and the many isomeric naphthalene intermediates f dyes; the manufacture of these and of the derive dyestuffs, alas, was by then largely in German hand He returned to the College as assistant professor i 1891, but left in 1902 to go to the Pharmaceutic Society and in 1904 became professor at Sheffield.

A. E. H. Tutton came to the Normal School as student in 1883 and, after work on the oxides phosphorus in collaboration with Thorpe, began abo 1892 the measurement and description of the crysta of organic substances prepared in the Chemic Laboratory. Self-taught in the subject, crystall graphy became the dominant passion of his life, a for forty years he investigated the effect produced crystal form and physical properties by the replac ment of one element by another in a series of alli compounds. In 1895 he became H.M. Inspector Schools (Technical), Board of Education.

G. T. Morgan was a student at Finsbury und Meldola. He first went into the dye industry Huddersfield for five years, and entered as a stude at the Royal College under Tilden in 1894. There quickly passed to the staff and began a varied resear programme indicative of the width of his futu interests. He stayed there until his appointment Dublin in 1912. Four years later he went to Finsbu and in 1919 to Birmingham, becoming in 1925 t director of the Chemical Research Laborato instituted after the War of 1914–18 as part of t

Government scheme for promoting industry on scientific lines. Morgan inspired a large number of students, a high proportion of whom went into industry; and he turned his attention continually to new fields of investigation, showing remarkable versatility. Diazo reactions of aromatic diamines; organic compounds of phosphorus, arsenic and antimony; high-pressure reactions; base exchange materials; synthetic resins; low-temperature tars, were only a few phases of his activities. Few men have done more than Morgan to carry the torch kindled by Hofmann along the highways of England, and to take chemical knowledge and scientific method into the lives of many as teacher, colleague and friend.

M. O. Forster likewise started at Finsbury, then went to Würzburg, where he took his degree and came back to the Central as Salters' Company Research Fellow. He came to the Royal College as demonstrator in 1895, being promoted assistant professor in 1902, a post he held until 1913. Forster carried out a brilliant series of organic researches from the College and was an inspiring influence there. He went to British Dyes during a troubled period, was later first director of the Salters' Company's Institute of Industrial Chemistry and four years later went to Bangalore as director of the Indian Institute of Science, where he did outstanding work for Indian science.

J. C. Philip, an Aberdonian and a pupil of Japp, studied under Nernst in Göttingen, and after a year with H. E. Armstrong at the Central gave a course of lectures in physical chemistry at the Royal College at the invitation of Tilden; he became lecturer there in 1900, assistant professor when Thorpe returned to the chair in 1909, and professor of physical chemistry, a new appointment, in 1913. From then until his death in 1941, Philip was responsible for this all-important subject. He was a teacher of great ability, and did much to establish a school of research in physical chemistry in the College during a period of very rapid growth of this branch of science.

J. F. Thorpe was a student of the Royal College in 1892–93, but developed largely under the influence of Auwers in Heidelberg and of W. H. Perkin, jun., at Manchester. He came back to the College when the chair of organic chemistry was created there in 1913, and there attracted and inspired a following of staff and research students in part because of his remarkably neat and effective technique. Under his leadership, research in organic chemistry flourished in spite of the interruption caused by the First World War. J. F. Thorpe later devoted the greater part of his time to administrative work and to Government committees, but the school continued to flourish under his assistants, among whom were included Ingold, Linstead, Farmer and Kon.

The College has played its part also in the provision of standard chemical literature without which the progress of research would be greatly hampered. The famous "Thorpe's Dictionary of Applied Chemistry" was first published in 1890 in three volumes: in its compilation, Sir Edward Thorpe had the assistance of many of the College staff besides outside collaborators. A second edition in five volumes began to appear in 1912, and a third in 1921. The First World War emphasized the value of the work and the need for a further revision. This was undertaken by J. F. Thorpe and M. A. Whiteley, thus maintaining the association of the "Dictionary" with the chemistry staff at South Kensington. It has become clear that pure science and technology cannot be divorced in a dictionary, so that the fourth edition of "Thorpe" now in progress is much wider in scope. Begun by Sir Jocelyn Thorpe and Dr. Martha A. Whiteley, it is being continued by a board of editors of which Prof. I. M. Heilbron is chairman, Dr. H. J. Emeléus a member, with Dr. Whiteley as editor and Dr. A. J. E. Welch as assistant editor.

Chemists are not unmindful of the important services rendered by A. J. Greenaway (1871–81) as sub-editor of the *Journal* and *Abstracts of the Chemical Society* over a period of forty years.

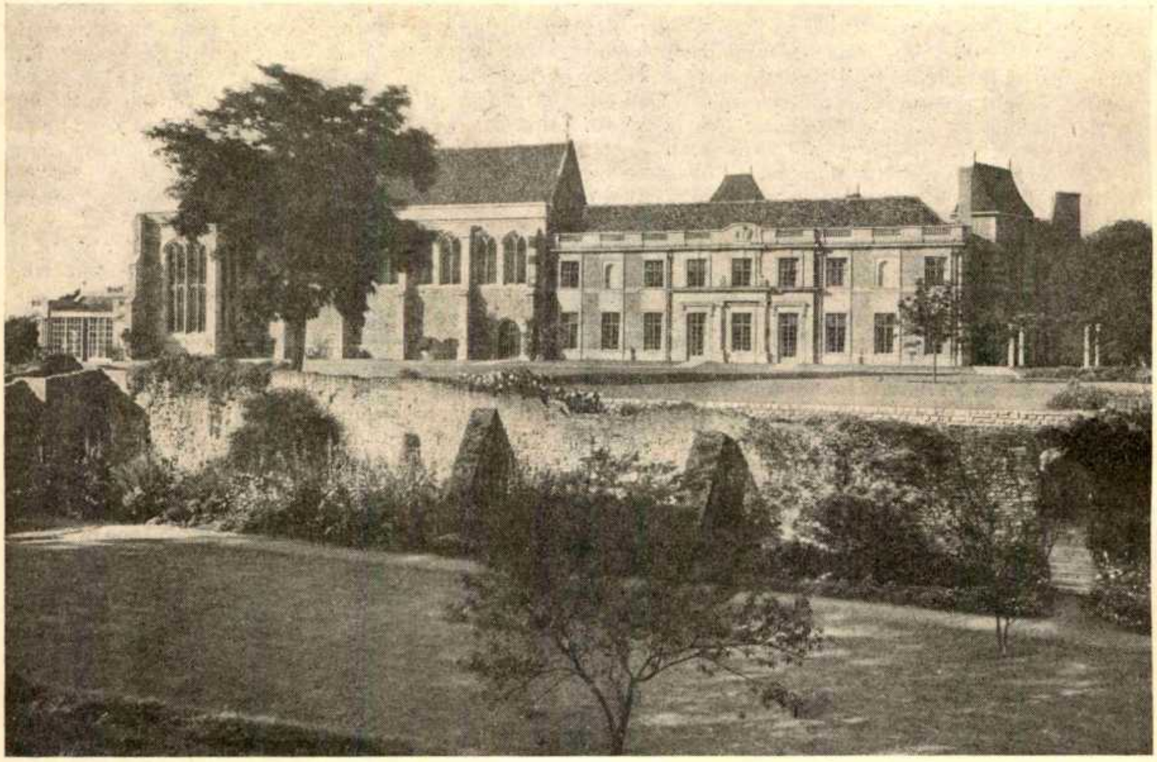
Examination of the "Register of Old Students of the Royal College of Science" confirms the impression that, in the closing years of last century, associates in chemistry found employment more easily in teaching than in industry. The title 'Normal School' was, rightly or wrongly, regarded as favouring this preference, owing to connotation with the French *Ecole normale*, although the methodology and discipline of pedagogy never formed part of the curriculum. But this preference for teaching posts need not be ascribed to predilection, as chemical industry offered relatively few openings and these none too well remunerated, with little or no assurance of security of tenure. But with the awakening of Britain to the growing need of scientific training and aptitude in industry, an improvement in prospects set in, which quickened with the growth of the present century. With the outbreak of the First World War, widespread deficiencies were revealed, and the supreme importance of research in so fundamental a subject as applied chemistry, woing to its manifold aspects in connexion with explosives, coal, oil, metallurgy, pharmaceuticals, plastics, fabrics, food products, etc., could no longer escape recognition. Then followed the establishment of the Department of Scientific and Industrial Research, with its research associations of manufacturers, and to-day cogent evidence of the imperative need of chemistry is witnessed by urgent advertisements in the daily and technical Press and combing of the Central Register for chemists. In its contribution to the yearly academic output of some four hundred first-class honours graduates in chemistry shortly before the outbreak of the present War, and their absorption in teaching and industry, it may be claimed without fear of contradiction that the College has faithfully fulfilled the purpose of its founders—that of promoting the application of chemistry to the "Arts and Manufactures".

THE ARMY SCHOOL OF EDUCATION, ELTHAM PALACE

By Major T. H. HAWKINS

ANOTHER chapter in the development of adult education in Great Britain has been begun with the opening of the new Army School of Education at Eltham Palace in Kent. To those who believe that the main cultural impact on adults is social rather than strictly educational, the choice of this historical setting with its rich associations will give real pleasure.

The Palace dates far back into history. In the time of Alfred there was "a goodly residence amidst these estates" and the dwelling and demesne are mentioned in the Doomsday Book. Edward the Confessor found spiritual calm at Eltham, and the abode was of sufficient magnificence to support the whole court of Henry III on various occasions. Edward I and II both lived for a while in this Kentish Palace, and in their time the stewardship was entrusted to Antony Bek, Bishop of Durham, who not only beautified the place, but sited and built the moat and its walls in 1300. Much of this work is extant, as is the original stone bridge built in 1396 by command of Richard II. In the reign of Edward IV the Great Hall, with its superb hammer-beam roof, was built, and since 1479 this building has stood, almost the hub of the realm in the time of Henry VII and Henry VIII, both of whom lived at Eltham, until during the Parliamentary Wars the whole estate was razed, all but the hall itself, the timbered roof and stout walls of which offered shelter to herds of cattle.



ELTHAM PALACE. THE GREAT HALL AND NEW BUILDING FROM ACROSS THE MOAT. COPYRIGHT *Country Life*.

Little restitution was effected until 1911, the Hall remaining only a rallying point for historians and painters; but in that year some repairs were made by the Ancient Monuments Department. In 1933 the lease was acquired by the Courtauld family; the Hall was restored, new wings added, and decrepit and extraneous dwellings which had encroached upon the estate were pulled down. About a year ago the lease was generously returned to H.M. the King.

Enough has been said to show that an atmosphere has been provided in which the spirit of education can unfold in the noblest of traditions. But what of the content of the educational programmes that are to be devised and carried out in the new school? This can be appreciated only by considering the background of the educational work of the Army as a whole. Before the defeat of Germany, arrangements had been made whereby every man and woman in the Army should, as soon as was practicable, be given opportunities to do six hours educational work each week. This was to be run by the Army for the Army and in the King's time. The Army Educational Corps was to be responsible for the general administration and supervision of the scheme; but in units the responsibility for organizing the educational work devolved upon commanding officers and unit education officers. The Education Branch at the War Office was charged with providing books, materials and equipment, and with drawing up necessary schedules of accommodation.

With the defeat of Germany it was decided by the Army Council that, in those units where it was possible, this Army Education Scheme should be implemented from July 1, 1945. This was carried out and, since that time, an increasing number of units, both at home and overseas, has inaugurated extensive educational schemes in their units. recent estimate, for example, suggests that abou 65 per cent of the units in one District in Great Britai is carrying out the Army Education Scheme, in fu or in part, as originally propounded. In B.A.O.R C.M.F. and M.E.F. many difficulties have bee encountered in addition to those which have bee faced by units at home; but in these theatres, to the task of providing opportunities for education activities is being tackled with good results.

This, briefly, is the picture in which the openi of Eltham Palace as an Army School of Educatio acquires significance. However near to perfecti was the gigantic Army Education Scheme as plann by the War Office Education Branch, until it w tried out in practice it could not be anything but paper scheme. Experience has already shown th in many respects the planned scheme had laid t great emphasis on what the men and women oug to demand and not, in fact, what they have d manded. The original pattern for developing the scheme which had been devised by the War Office has, in many cases, been superseded by arrangements which the units consider to be improvements on any scheme which could emanate from the War Office. In short, the infant which was perfectly conceived some months ago is now going through all the pangs of infancy.

What does the War Office do in such cases ? Many observers labour under the belief that any deviation from orthodox War Office programmes on the part of military units is tantamount to quick extinction for the individuals concerned. However much this may be true of some War Office Departments, it is certainly untrue of the Education Branch, and units have been left to develop educational schemes which would best suit their local conditions. This has led to improvisations and experiments which have enriched the scheme as a whole, and, whenever possible, new ideas and suggestions have been incorporated into the general scheme and made available for the use of other units.

Here lies one of the main purposes of the new Army School of Education. From time to time Army Educational Corps officers are to be brought in for short courses to discuss the practical difficulties which are being met with in the field and whether they are being surmounted and by what means. Most of these officers will be drawn in from home commands, but occasionally they will be joined by officers from overseas theatres, and, lest their discussions tend to concentrate too severely on the supervisory and administrative difficulties, these Army Educational Corps officers are to be joined on various courses either by the unit education officers who are concerned with the fine details of the scheme in the units themselves, or by commanding officers who are responsible for seeing that good educational facilities are being provided for men and women under their command. The interchange of ideas between those who are concerned with running the scheme on the ground and those who have planned and are responsible for the broad principles of the scheme, as well as the general details of administration, should be of great service to the soldiers and auxiliaries who are anxious to make use of the opportunities provided.

Nor can a scheme which aimed to provide educational facilities for at least six hours weekly to some four to five million adults be carried out without a large administrative and organizing staff. About a year ago the Army Educational Corps began to expand rapidly, but even apart from the expected wastages through demobilization, the number of officers in the Army Educational Corps is still very inadequate to carry out effectively their difficult role. The number of candidates who are anxious to transfer o the Corps is fortunately very high, and another of the duties of the new School is to provide courses whereby suitable applicants may be graded and assessed as to their suitability for transfer. This is done by testing their ability in organizing and instructional technique, by their contributions to discussions and the work of the School as a whole, as well as their general demeanour. Again, the interplay of ideas between those transferred and those already experienced in army education in the field hould be of considerable value to the new entrants o the Army Educational Corps.

Even then the functions of the School are not exhausted. In some theatres of war, particularly ndia, some Army Educational Corps personnel have been primarily concerned with the teaching of English to Indians and of Urdu to British personnel, and have had little chance of finding out the tremendous developments in army education during the later years of the War.

These individuals have often been overseas for periods of not less than seven years and, when they come home, feel an urgent need for 'refresher' courses where they might be brought up to date with the latest developments in army education. For these, Eltham Palace also makes provision.

So far, one course only has been held, and its success augurs well for future arrangements. The discussions between those already experienced in army education and who are anxious to share their experiences with similar individuals, those who are keen to become members of a Corps which has won good report during the War, and those whose experiences have been in other directions and who need re-orientating, have already shown the value of such a School and the interest that will accrue to it with each successive course.

One of the sessions, which should be of considerable use to adult education, is that in which officers discuss the Army Education Scheme and its carry-over to the national educational system. It is well known that, before the War, the vast majority of the adult population had been unattracted by any of the educational movements which, on the whole, had been providing sustenance only for those already converted. Bound up with this was the fact that most of the classes provided were too academic and paid too little regard to the variety of human interests. Further, there had been an unsatisfactory and unnecessary division between vocational and non-vocational subjects. From the early days of the War, Army educationists had adopted a different policy and, from the beginning, sought to provide educational opportunities not for the few but for the many. Their role as proselytes has taken them up many gum-trees ; but the spirit in which the work has been tackled has led them to attempt experiments and improvisation which have often opened new doors to the education of adults.

The new technique which has been most successful is the use of the informal discussion method for stimulating initial interest in what might, to the group, be a new subject. Another is the use of visual aids, and, already, both in direct teaching and in information rooms, the Army has set up a standard of which it is rightly proud. The value of residential education for adults has been argued persuasively by, among others, Sir Richard Livingstone, and there is no need to repeat the advocacy.

In the many hundreds of residential courses which the Army has run, considerable experience has been gained not only in the organization of such courses but also in framing programmes which would be most effective in the short periods available. Other work which has long since passed the experimental stage has been done for patients in hospitals and convalescent homes and for soldiers under sentence in military prisons and detention barracks. So, too, has the remarkable work in basic education which has succeeded in transforming the lives and values of many former illiterates. At present, experiments in the use of educational broadcasts are being made and their progress is being carefully noted.

The discussions on all these topics have been framed so that officers can make concrete suggestions from their own army and civil experience as to the most suitable means of transferring these new devices in adult education to the civil education system. Army educationists are well aware that during the War a new interest in adult education has been built up and they are anxious that this interest shall be directed into useful channels before it evaporates; hence the need for careful deliberations before the mass of men and women are demobilized and for quick action afterwards.

The Ministry of Education is fully alive to the need for the immediate capitalizing of this newly gained interest in education by adults, and it is pleasing to report that here, too, Eltham Palace is to play a useful part. At the time of writing, more than a score of His Majesty's Inspectors are attending a short course to learn the main principles of the Army Education Scheme. Very shortly they will go to commands at home and overseas to see how effectively the Army Education Scheme is working on the ground. After a few months of this field work, they will come together again, their recommendations collated and transmitted to the Ministry for any action that is thought desirable.

Eltham Palace has been on the map for some five hundred years. Its significance in history, like good wine, needs no bush. In contemporary affairs it has acquired a new meaning. That lies in the choice of the Palace as an Army School of Education with the clear recognition that worthwhile education deserves a home where it can prosper and flourish.

The Army Council is to be congratulated on securing this magnificent building for what will now become the permanent home of the Army Educational Corps. On October 25 it was officially opened by the Parliamentary Under-Secretary of State for War, Lord Nathan. He was supported by General Sir Ronald Adam, the Adjutant-General to the Forces, and many other distinguished men and women. The first Commandant of the School is Lieut.-Colonel W. S. Beddall.

OBITUARY

Prof. F. Vejdovský

Six years ago it was noted in these columns that Prof. F. Vejdovský, the distinguished Czech zoologist, was then about to celebrate his ninetieth birthday (see *Nature*, **144**, 276, 1939; with portrait). It is now learned, with regret, that he died shortly afterwards, so the following additional notes may interest his numerous friends and colleagues all over the world.

František Vejdovský was born at Kouřim (Bohemia) on October 24, 1849. After passing through the Latin School, he matriculated in the philosophical faculty (natural sciences) of the Charles University of Prague, and took his doctor's degree in 1876. In the same year he became assistant to Prof. A. Frič at the Zoological Institute. Next year (1877) he was appointed lecturer in zoology at the College of Technology (Prague). In 1879 he held the post of lecturer in zoology and comparative anatomy in the University, becoming extraordinary professor in 1884. In 1892 he was elected professor of zoology, comparative anatomy, and embryology, and thereafter continued to direct the Czech Zoological Institute until 1921, when he retired as professor emeritus. His period of office covered, therefore, the rebuilding and reorganization of the Institute, and the War of 1914–18. In addition, he was dean of the philosophical faculty in 1895–6, and Rector Magnificus of the Charles University during 1912–13. For many years he was president of the Royal Society of Sciences of Bohemia, and remained honorary president of the Zoological Society of Czechoslovakia until the day of his death. Various other societies in France, Belgium, Poland, Russia, Jugoslavia, and the United States long ago enrolled him as a member; while England, represented by the University of Cambridge, conferred an honorary doctorate upon him on the occasion of the Darwin Celebration in 1909.

For more than half a century Vejdovský was the revered *doyen* of Czech zoologists, and by his own work and his teaching exercised an enduring influence on the development of zoology in his own country. His influence was also deeply felt abroad. Most of his own researches dealt with various groups of invertebrates (Protozoa, Porifera, Turbellaria, Annelida Nematoda, Crustacea, etc.), and were morphological, cytological, embryological, and systematic. They cover an unusually extensive field. He was especially interested in spermatogenesis, and problems connected with the centrosome and chromosomes, but also devoted much study to freshwater hydrobiology. On these and other matters he published some ten large treatises and more than a hundred other memoirs in Czech, English, French, German, and Belgian periodicals. His most important works are the "Thierische Organismen der Brunnenwässer von Prag", and the discovery of the remarkable crustacean *Bathynella* (1882); the "System und Morphologie der Oligochaeten" (1884); his classical researches on *Gordius* (1886 and onwards); "Zrání, oplození a rýhování vajíčka" [Maturation, fertilization and cleavage of the ovum] 1886; "Entwicklungsgeschichtliche Untersuchungen" (1888-93); "Neue Untersuchungen über die Reifung und Befruchtung' (1907); "Zum Problem der Vererbungsträger (1912), and his final work (in English) entitled "Structure and Development of the 'Living Matter' " (1926–27)

This last book embodies Vejdovský's ultimate conclusions and opinions on many problems of cytology—on spermatogenesis, reduction, the structure of chromosomes, cytoplasmic inclusions, the origin of the centrosome, and the organization and genetic continuity of cell-constituents generally. It is a big volume of 360 pages with 24 double plates (containing 579 figures admirably drawn by his own hand), and is a notable achievement for a man nearing his eightieth birthday. Much of this work was done during the War of 1914–18, under extreme difficulties, and it completion and publication—in a foreign language—afford convincing evidence of its author's industry and erudition.

Vejdovský died at Prague on December 4, 1939 Shortly before his death, his ninetieth birthday wa celebrated by the publication of a *Festschrift* to which many of his colleagues, friends, and pupils contributed. It is an octavo of over six hundred pages with a portrait and full bibliography of his publications, and entitled "Sborník prací vydaný k 90 narozeninám Prof. Dr. Františka Vejdovského Královskou českou společností nauk a Čs. zoologicko společností v Praze [Collection of works edited fo the 90th birthday of Prof. F. Vejdovský by the Royal Czech Society of Science and the Czechoslova Zoological Society of Prague]". It forms vols. VI–VI of the Proceedings [Věstník] of the Zoological Society for the year 1938–39 (Prague, 1939). As yet onl one copy of this volume—surely unique in the annals of zoology—appears to have reached England.

CLIFFORD DOBELL.

NEWS and VIEWS

rof. W. T. Astbury, F.R.S.

IN 1928 the Worshipful Company of Clothworkers of the City of London made a grant of £3,000 a year o the University of Leeds for research purposes. Never has a grant been more fully justified, for it esulted in the appointment of Dr. W. T. Astbury as ecturer in textile physics and induced him to take up the study of proteins. A scholar of Jesus College, Cambridge, Astbury had acted as assistant to Sir William Bragg, first at University College, London, during 1921–23, and then at the Davy Faraday Laboratory of the Royal Institution during 1923–28. At Leeds, therefore, X-ray studies of hair, wool and elated fibres claimed his immediate attention, and he main features of the molecular structure of the keratins were defined in two papers published in the *Philosophical Transactions of the Royal Society* in 1931 and 1933. The industrial importance of this and other work was recognized by the award of the Gold Medal of the Worshipful Company of Dyers in 1934, and the Warner Memorial Medal of the Textile Institute in 1935. Its implications in the biological ield were even more profound: assisted by generous grants from the Rockefeller Foundation since 1933, he utilized his concept of folded and extended polypeptide chains, derived from the examination of unstretched and stretched wool fibres, to obtain a structural interpretation of the denaturation phenomenon, and, later, to identify the keratins, myosin, fibrinogen and fibrin as belonging to the same group of proteins.

The extent and importance of Astbury's work on the structure and stoichiometry of the proteins have been recognized by the award of the Actonian Prize of the Royal Institution in 1935 and the Sc.D. of the University of Cambridge in 1937; by his promotion to reader in textile physics at the University of Leeds n 1937; and by his election to the fellowship of the Royal Society in 1940. This year he has had the distinction of being the Croonian Lecturer of the Royal Society, and the many admirers of his work will now rejoice to know that the University of Leeds has elected him to the chair of biomolecular structure, which was instituted in his honour.

Royal College of Physicians: Medal Awards

THE following awards have recently been made by he Royal College of Physicians:

Moxon Medal to Sir Alexander Fleming, for his work on penicillin, as an outstanding contribution to herapeutics and clinical medicine. This award, which s not restricted to British subjects, is made to the person who is deemed to have most distinguished himself by observation and research in clinical medicine.

Weber-Parkes Prize and Medal to Prof. Eugene L. Opie, professor of pathology, Cornell University, New York, for his work on the pathogenesis of pulmonary uberculosis. This Medal is awarded every third year or the best work done whether in Great Britain or abroad upon some subject connected with the tiology, prevention or treatment of tuberculosis.

Baly Medal to Prof. S. A. S. Krogh, of the Zoophysiological Laboratory, Copenhagen, who has made outstanding contributions to our knowledge of the capillaries and of related physiological problems in cellular nutrition and respiration. This award is made every alternate year to the person who shall be deemed to have most distinguished himself in the science of physiology, especially during the two years immediately preceding the award, and is not restricted to British subjects.

Fifty Years of X-Rays

IN the history of science there have been few more unexpected and few more fruitful discoveries than that made by Wilhelm Konrad Rontgen on November 8, 1895, and described not many days after in his paper "Über eine neue Art von Strahlen" read to the Physico-Medical Society of Würzburg. Copies of the paper reached England early in 1896, and *Nature* of January 23, 1896, contained a translation of it. By those fortunately in possession of the necessary apparatus, Rontgen's experiments were repeated with delight and wonder, and not only that, they were put to very good purpose. In Berlin, on January 20, 1896, a medical man had with the new methods detected a glass-splinter in a finger, and at Liverpool on February 7, Dr. C. T. Holland found by X-rays a bullet in a boy's hand. None had received news of the discovery with greater interest than Sir Arthur Schuster, who in his book "The Progress of Physics during Thirty-three Years", published in 1911, tells how his laboratory was inundated by medical men with their patients, among whom was a ballet dancer whose trouble had been diagnosed as bone disease but who all the time had a needle in her foot. In April he and his assistants were called to Nelson, Lancashire, to a woman who had been shot by her husband and whose head Schuster explored with the new rays. There was no opposition to the application of Rontgen's discovery, as there had been to those of Lister and Pasteur, and medical science and surgery have benefited universely from it. Even after two world wars, it may be that X-rays have saved more lives than bullets have destroyed.

Medical aspects, however, are a small part of the story, for Rontgen's work influenced all physical studies. In the jubilee number of *Nature*, November 6, 1919, Sir Ernest Rutherford, as he then was, wrote that the discovery "marks the beginning of a new and fruitful epoch in physical science in which discoveries of fundamental importance have followed one another in almost unbroken sequence". Sir William Bragg said much the same thing, and none did more than these two distinguished men to further the use of X-rays for unfolding the secrets of Nature. Rontgen was born at Lennep, in the Ruhr, on March 27, 1845 (see *Nature*, March 24, 1945, p. 351), and was thus in his fifty-first year when he achieved fame. In 1894 *Nature* had referred to his collaboration with August Kundt, but he was then little known. His single observation, however, wrote his name indelibly in science, and among his rewards was the Nobel Prize of 1901. Before 1895 he had worked at Würzburg, Strassburg and Giessen and had returned to the first in 1885. His latter years were spent at Munich, first as director of the Physical Institute and from 1919 in retirement. He died there on February 10, 1923, having seen others reap a rich harvest from the seed he had sown.

Research in Britain on Atomic Energy

IT was announced by the Prime Minister on October 29 that the Government, acting in accordance with a recommendation from the Advisory Committee on Atomic Energy, has decided to set up a research and experimental establishment covering all aspects of the use of atomic energy. The station will be at Harwell airfield, near Didcot. Responsibility for research on atomic energy, which hitherto has rested on the Department of Scientific and Industrial Research, is to be transferred to the Ministry of Supply, and the Tube Alloys Directorate which dealt with such matters is accordingly being transferred to the Ministry. The whole of the cost of research in this connexion will fall on the Government. In reply to a question asking whether this change of control means that the Government is more concerned with the weapon value of atomic energy than its production value, Mr. Attlee remarked that this was not so, and that the Ministry of Supply is engaged in civilian production as well as production for the Services.

On October 30, Mr. Attlee stated in the House of Commons that he is to visit President Truman in Washington "to discuss with him and the Prime Minister of Canada the problems to which the discovery of atomic energy have given rise"; Sir John Anderson, chairman of the Advisory Committee on Atomic Energy, is to accompany him in an advisory capacity.

French Association for the Advancement of Science

THE French Association for the Advancement of Science held a large and enthusiastic Congrès de la Victoire in Paris during October 20–26. This was the first assembly of its kind to be held since 1939, the usual annual meetings having been suspended during the period of the War. At the invitation of the Association, delegates were present from Great Britain, the United States, Canada, the U.S.S.R., Argentine, Switzerland, Belgium, Sweden, Norway, Czechoslovakia and Rumania. About fifteen hundred members of the Association and the delegates were present at the opening meeting in the Great Hall of the Sorbonne on Saturday, October 20. The president of the Municipal Council of Paris opened the proceedings with a welcoming speech, which was followed by discourses delivered by Prof. Joliot-Curie and Prof. Justin-Besançon, president of the French Red Cross.

Prof. Henri Piéron, who had been elected president of the Association at the Liège meeting in 1939, delivered his presidential address after the chief delegates had paid tribute to the vitality of French science and its renewed vigour, in the addresses presented by them. The British Association delegation was headed by its president, Sir Richard Gregory, who read the address sent by the Association; the other delegates from Great Britain were Sir Thomas Holland and Dr. W. Campbell Smith, members of the Council of this Association, Sir Edward Appleton and Prof. E. N. da C. Andrade, with Lady Gregory representing the lady members. The inaugural meeting lasted from three to six o'clock in the afternoon.

The twenty-two sections met separately or jointly in six scientific institutions during the week, and with full programmes of papers. Sir Edward Appleton gave a lecture on the ionosphere on the afternoon of October 22 to a joint meeting of three sections, and he and Prof. Andrade afterwards made two short broadcasts at the request of the radio officer attached to the British Embassy. A reception was given on the evening of October 24 at the Hôtel de Ville and there was a banquet on October 25 at the Salons Vianey. At the general assembly on October 26, the president and other officers of the Association for the ensuing year were elected and other officia business transacted. On the same evening the Britis Ambassador and Lady Diana Duff Cooper gave reception at their official residence to the foreig delegates and officers of the Association and othe distinguished representatives of scientific societies i Paris.

Middle East Field Biology

THE presence of numerous amateur and professiona zoologists among the British Forces in the Middl East countries during the War has resulted in a considerable amount of field biology being carried ou in those countries, much of which is now being published. The anti-locust work of British units an frontier defence forces also aided. The Zoologica Society of Egypt has issued numerous special bulleti to accommodate these original observations, mainl upon ornithology. Bull. 7 issued in 1945 contain Shamseddin Halfawi's "Notes on Birds from Wester Saudi-Arabia". Bull. 6 contains bird notes fro Lower Egypt (autumn, 1943), and from Amriya Egypt (July–October 1942), and a list of migrant seen in Egypt, the western desert and Tripolitania while special supplements to this bulletin were devoted to papers on Palestine and Syria, and to th migration of the white stork. Bull. 2 contains valuabl notes on the birds of Suez, and Bull. 5 has notes o bird migration across the western desert and Libya Especially interesting are the bird notes from th Daedalus lighthouse in the Red Sea, augmented b the British keeper at the lighthouse, as they supplement some of the earlier work of Meinertzhagen i the First World War.

The Army itself has published much through it Middle East Biological Scheme, organized fro G.H.Q. to collect specimens for the British Museum and with naturalists' clubs in Baghdad, Jerusalem Damascus and Cairo publishing regular bulletins Collecting expeditions have been organized throug the scheme over periods of several days or weeks a Lake Tiberias, Lake Huleh, Mt. Cassius in Syria etc., the Anti-Lebanons have been surveyed, an several expeditions have been made in the Euphrate valley, bringing up to date "The Survey of Ira Fauna" published by the Bombay Natural Histor Society (1915–19), with the work on birds, mammal insects and reptiles in Mesopotamia collected an studied by soldier naturalists in Mesopotamia durin the First World War.

History and Philosophy of Science

PRIOR to 1939, the Departments of the Histor and Philosophy of Science and of the History o Medicine at University College, London, which wer the only departments of their kind in Great Britai provided either full-time or part-time postgraduat courses of one and two years. On an average th department accommodated 30–35 students. Wit the full return of University College to London th autumn, the Department has been reopened. It hoped shortly to make an appointment to the po of professor and head of the Department, which at present vacant; but, in the meantime, cours in the history of science are being provided by members of the pre-war staff. Although the session commenced on October 1, arrangements have been mad whereby intending students will be able to commen the first year's course so late as January 1946 wit out loss of opportunity.

Diseases of Cereals

CORRECT diagnosis is of prime importance for the successful prevention and control of plant disease, and considerable confusion is frequently caused by the loose use of terms such as 'blight', 'rust' or 'mildew'. The Ministry of Agriculture has accordingly published Bulletin No. 129, compiled by W. C. Moore, entitled "Cereal Diseases" (London : H.M. Stationery Office. 1*s.* net), which should prove of great value to all interested in the cultivation of these crops, whether it be the farmer, scientific adviser or student of agriculture. It provides simple, accurate and, in a number of cases, illustrated descriptions of the diseases of cereals that occur in Great Britain, together with the measures that should be taken to prevent or control their incidence. The diseases causing the most damage are yellow rust, bunt of wheat, leaf spot of oats, leaf stripe of barley, take-all, eyespot, mildew and manganese deficiency disease; but even these vary in intensity from season to season and in some years others are of equal importance. A farmer experiencing trouble with cereal crops is urged to seek advice from his County War Agricultural Committee, and a list of provincial advisory centres and advisory mycologists is appended from whom help may be obtained.

Californian Marine Algæ and Grasses

E. YALE DOWSEN has compiled a most useful "Annotated List of the Marine Algæ and Marine Grasses of San Diego, California" (*Occas. Papers, San Diego Society of Natural History*, No. 7, March 1945). This is intended primarily for the amateur, and is simplified as much as possible. Directions are given for collecting, preserving and examining marine algæ, and there are also keys to genera and list of species with habitats, notes on marine grasses, a glossary of terms and a bibliography. With this little manual much may be accomplished by anyone interested in these plant groups.

Royal Society of Edinburgh

THE following have been elected officers and members of council of the Royal Society of Edinburgh: *President:* Sir W. Wright Smith; *Vice-Presidents:* Dr. Alan W. Greenwood, Dr. E. Hindle, Dr. David Russell, Prof. R. J. D. Graham, the Right Hon. Lord Cooper, Prof. J. W. Heslop Harrison; *General Secretary:* Prof. James Kendall; *Secretaries to Ordinary Meetings:* Prof. E. T. Copson, Prof. A. Holmes; *Treasurer:* Sir E. Maclagan Wedderburn; *Curator:* Dr. John E. Mackenzie; *Councillors:* Lieut.-Colonel W. F. Harvey, Prof. A. E. Trueman, Prof. J. Walton, Prof. T. Alty, Mr. J. Morrison Caie, Sir Robert Muir, The Hon. Lord Birnam, Prof. E. P Cathcart, Prof. A. Gray, Dr. J. Russell Greig, Dr. W. A. Harwood and Prof. C. M. Yonge.

University of London

THE following appointments have been made by he University of London: Dr. A. I. Richards, pecial lecturer in social anthropology at the London School of Economics, has been appointed to the University readership in anthropology tenable at the School as from October 1. Dr. Margaret Read, lecturer in social anthropology at London School of Economics and since 1940 head of the Colonial Department at the Institute of Education, has been appointed to the University readership in education tenable at the Institute of Education as rom October 1.

Dr. James Henderson, lecturer in mathematics at King's College, London, has been appointed academic registrar of the University as from January 1, 1946, in succession to Colonel S. J. Worsley, who has been appointed principal of the College of Estate Management.

The following doctorates have been conferred: D.Sc. on Robert Brown (Imperial College); D.Sc. (Eng.) on C. M. White (Imperial College); D.Sc. (Eng.) on Norman Davey.

Announcements

THE Nobel Prize for Medicine for 1945 has been awarded jointly to Sir Alexander Fleming, of the University of London, Sir Howard Florey and Dr. E. B. Chain, of the University of Oxford, for their work on the discovery and utilization of penicillin.

SIR JOHN BOYD ORR has been appointed the first director-general of the United Nations Food and Agricultural Organization.

DR. H. LIPSON, of the Cavendish Laboratory, Cambridge, has been appointed head of the Department of Physics in the Manchester College of Technology in succession to Dr. W. H. Taylor.

PROF. L. P. GARROD, professor of bacteriology in the University of London, is visiting Belgium to lecture on penicillin to medical audiences, at the invitation of the University of Louvain and under the auspices of the British Council.

THE British Association announces the reopening of the Charles Darwin memorial rooms at Down House, Downe, Kent, daily excepting Fridays, from 11 a.m. to 5 p.m. The exhibits were uninjured during the War, and since they were last on view a number of additions have been made.

THE Council of the Geological Society of London has accepted an offer made jointly by the Anglo-Iranian and the Burmah Oil Companies to provide a fund of £750 per annum, for an initial period of seven years, to be used to defray the costs of an instructional tour for about twenty students taking honours courses in geology at various universities and colleges. Each tour will probably extend over three weeks and will include visits to classic geological sections. It will be arranged to supplement the field instruction normally provided by the universities.

DR. E. W. GUDGER, Department of Fishes, American Museum of Natural History, New York City 24, N.Y., states that the "Bashford Dean Memorial Volume: Archaic Fishes" is now complete in Articles I–VIII, plus index, introduction, two title pages and two tables of contents—for binding as Parts I and II. Those who receive such material regularly from the American Museum are invited to apply for any parts which may be missing. Duplicate lithographed plates of the segmentation of the egg (2) and of the genital system of *Bdellostoma* (4) are also available.

REFERENCE was made in *Nature* of October 27 (p. 502) to the commemoration of the anniversary of the discovery of X-rays. The joint meeting of all the participating societies will be held at the Phoenix Theatre, Charing Cross Road, London, W.C.2, on November 9, at 3.30 p.m., instead of at the Central Hall, Westminster, as originally arranged. There will also be a small exhibition of historical apparatus in the Reid Knox Hall of the British Institute of Radiology, 32 Welbeck Street, London, W.1, during November 8–10 (10 a.m.–6 p.m.).

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

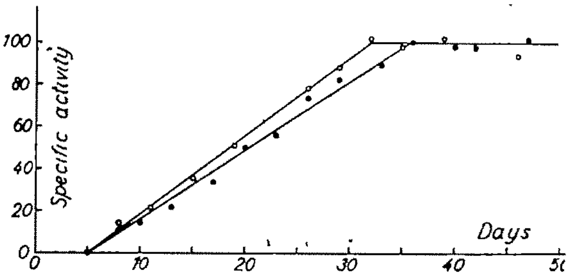
Life-Cycle of the Red Corpuscles of the Hen

THE life-cycle of the mammalian red corpuscles is not known with certainty. Values varying between 30 and 200 days are recorded. One would expect the problem to be easily solved by making use of an isotopic indicator, that is, by labelling the corpuscles. In trying to find a suitable indicator, great difficulties are encountered, due to the fact that almost every compound present in the corpuscles is renewed at a comparatively rapid rate. Only such labelled molecules which have a longer life-time than the red corpuscles in which they are located can be used as indicators. Iron atoms incorporated with hæmoglobin molecules remain unchanged during the life-time of the red corpuscles[1]. Hahn and his colleagues[2], however, found that the iron atoms contained in the debris of the hæmoglobin of decayed corpuscles are preferentially used in the formation of new corpuscles. This fact makes radioactive iron unsuitable for the determination of the life-cycle of the red corpuscles.

We found desoxyribose nucleic acid phosphorus to be a suitable indicator for the determination of the life-cycle of nucleated corpuscles. In contradistinction to desoxyribose nucleic acid molecules present in various organs, those found in the red corpuscles of the hen are not renewed at an appreciable rate. In experiments *in vitro*, in which hen blood was shaken in an oxygen atmosphere in the presence of labelled sodium phosphate, no active desoxyribose nucleic acid was found to be formed, in contradistinction to other active phosphorus compounds. Furthermore, activity was absent in the desoxyribose nucleic acid present in the circulating red corpuscles of the hen up to five days after administration of radioactive phosphate.

Hen corpuscles, labelled by their active desoxyribose nucleic acid content, can be used in two different ways. We can administer, for example, labelled phosphate to the hen, and after the lapse of a week replace part of the corpuscles of a second hen by labelled corpuscles of the first one. When taking blood samples at intervals, we can determine what percentage of the transfused corpuscles is still present in the circulation of the hen. In a note to be published later, we shall communicate the results obtained in such experiments. In this note we shall describe another method in which, by avoidance of blood transfusion, the uncertainty about the equality of the life-time of the transfused corpuscles and the endogenous corpuscles can be eliminated.

In the latter method, labelled phosphate is administered twice a day to the hen in such quantities that the plasma phosphate is kept at a constant or almost constant level of activity. The active phosphate penetrates into the marrow and participates in the formation of the nucleic acid of the corpuscles, which thus become labelled. The percentage of labelled corpuscles will increase with time, and finally the circulation will contain labelled corpuscles only; thus the activity of 1 mgm. corpuscle desoxyribose nucleic acid phosphorus will be equal to the activity of 1 mgm. marrow phosphorus and 1 mgm. plasma phosphorus respectively.



LIFE-CYCLE OF THE RED CORPUSCLES OF TWO HENS. ABSCISSÆ: DAYS AFTER START OF EXPERIMENT; ORDINATES: SPECIFIC ACTIVITY OF DESOXYRIBOSE NUCLEIC ACID PHOSPHORUS EXTRACTED FROM THE CORPUSCLES SECURED AT DIFFERENT DATES.

The results of such experiments are shown in th accompanying graph, which makes it clear that i the first five days the nucleic acid present in th corpuscles is inactive. This may be interpreted b assuming that, in the first phase of the experiment corpuscles containing inactive nucleic acid reach th circulation, and that it is about five days befor corpuscles containing labelled nucleic acid are give off by the sinusoids to the circulation. The maturin of the corpuscles in the marrow thus takes abou five days. The graph also shows that, after the lapse o about thirty-three days, the maximum value of th activity of the desoxyribose nucleic acid is reache Taking into account that in the first five days n labelled corpuscles intrude into the circulation, th life-time of the red corpuscles will be 28 days. It of interest finally to note that the results obtaine indicate that all or almost all corpuscles present i the circulation have a similar life-time.

We wish to express our cordial thanks to Pro Niels Bohr, director of this Institute, and to Pro August Krogh and Dr. Albert Fischer in whos laboratories the investigation was continued whi the Institute of Theoretical Physics was under enem occupation.

G. HEVESY.
J. OTTESEN.

Institute of Theoretical Physics,
University, Copenhagen.

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[1] Hahn, P. F., Bale, W. F., Ross, J. F., Hettig, R. A., and Whippl G. H., *Science*, 92, 131 (1940).

[2] Hahn, P. F., Bale, W. F., and Balfour, W. M., *Amer. J. Physio* 136, 800 (1941–42).

Departure of Long-Wave Solar Radiatio from Black-Body Intensity

IN some recent experiments of great interest an importance, both Reber[1] and Southworth[2] hav succeeded in detecting and measuring solar radiatio in the short-wave end of the radio spectrum. T wave-length employed by Reber was 187 cm., whi the three wave-lengths used by Southworth, althoug not precisely specified, were of the order of 10 c and less. In both series of experiments it was foun that the intensity of solar radiation approximate conformed to that emitted by a black body at temperature of 6,000° K. In another series of expe ments of somewhat allied character, Jansky is r ported to have been unable to detect solar radiatio using a longer wave-length of 14·6 metres, althoug his apparatus was sufficiently sensitive to detect t electromagnetic radiation, which he discovered i 1931, coming from the vicinity of the Milky Way.

The object of this communication is to point out that there is evidence from radio reception experience, dating from the period of the last sunspot maximum, which suggests that during periods of marked solar activity, the sun occasionally emits radiation in the radio spectrum greatly in excess of black-body radiation corresponding to 6,000° K. Reber and Southworth do not appear to have observed these effects, possibly because their work was conducted during the present period of sunspot minimum.

My attention was first attracted to this phenomenon of abnormal solar radiation by Mr. D. W. Heightman (Amateur Station *G6DH*), who described hearing in 1936 a hissing sound when receiving in the range of 10–40 Mc./s. Other amateur observers sent me further excellent reports, from which I concluded that the noise was due to the emission of *electromagnetic* radiation from active areas on the sun. The noise was heard only in day-time and was often the precursor of a catastrophic fade-out associated with a bright eruption on the sun. It will be recalled that such fade-outs are due to marked intensification of *D*-layer ionization caused by outbursts of ultraviolet light from active solar areas; and it is natural to associate the radio noise heard before the fade-outs with the same areas. On the frequency band of 10–30 Mc./s. this temporary *D*-layer ionization is usually sufficient to attenuate the solar radiation which causes the noise; though from our knowledge of the magnitude of such attenuation, which varies as λ^{-2}, I should expect that extremely short-waves would make the single journey through the layer with only slightly diminished strength and so be detectable both before, and throughout, the fade-out.

It is possible to get some quantitative idea of the enhancement of the short-wave radiation from the sun on such occasions, for it is easy to show that the black-body radiation (although recently detected on extremely short waves) would be quite undetectable on the type of receiving aerial used in ordinary short-wave reception. The flux of solar energy received at the earth's surface is given by F, where

$$F = \frac{2\pi kT}{\lambda^2}\left(\frac{r}{R}\right)^2 \Delta f \text{ (ergs, cm.}^{-2}\text{, sec.}^{-1}) \quad . \; . \quad (1),$$

where k is Boltzmann's constant, T the effective solar temperature, λ the wave-length, r the radius of the sun, R the earth-sun distance, and Δf the frequency-acceptance band. Now if we receive such radiation using tuned half-wave dipoles as aerials, the power absorbed is proportional to λ^2 (Δf being kept constant). Therefore, with aerials of this type, the solar noise should be *independent* of wave-length. In fact, the received power is given by p, where

$$p = 0{\cdot}41kT\left(\frac{r}{R}\right)^2 \Delta f \quad . \quad . \quad . \quad (2)$$

Now it is easy to show that this power is only about 10^{-4} of the receiver noise associated with earth-surface temperature and, for that reason, solar radiation does not obtrude in wireless receivers of ordinary type.

When extremely short waves are used, however, it is possible to employ directive aerial systems (for example, parabolic mirrors) of large power gain G_r, and when such a system is appropriately oriented towards the sun, the value of p is increased by the factor G_r. It is therefore clear that to detect solar black-body radiation at *any* radio wave-length, it is necessary for the aerial power gain (relative to a half-wave dipole) to be of the order of 10^4. But with the wave-lengths used in long-distance reception, an aerial array giving a power gain of this order would be of prohibitive size; and in the cases of amateur reception cited above, the value of G_r cannot have been much greater than 4. It is therefore clear that during the periods when the noise was observable, the intensity of the solar radio flux from the active area was about 10^4 times that associated with the black-body radiation from the disk as a whole.

During the next period of sunspot maximum (1948–49), it should be possible to examine more fully the frequency spectrum of these additional radiations both before, and during, fade-out conditions, since sensitive receivers in the micro-wave region are now available. Indeed, with centimetre-wave sets using very large mirrors, and thus narrow cones of energy acceptance, it should be possible to examine one particular section of the sun's disk at a time and so roughly to locate the active areas. It should, however, be mentioned that, so far as the ordinary black-body radiation is concerned, once the cone of energy acceptance of the aerial system just accommodates the solid angle subtended by the sun's disk, there is no point in increasing the mirror size further; for any additional power gain effected by such an increase is then just compensated by the reduction in the area of the solar disk which can be 'seen' by the 'radio-telescope'.

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Sept. 24.

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[1] Reber, *Astrophys. J.*, **100**, 279 (1944).

[2] Southworth, *J. Franklin Inst.*, **239**, 285 (1945).

Indexes of Data for Identification Purposes

FOR the purpose of identifying crystalline solids three indexes have been initiated. (1) The Barker index of morphological data (derived from measurements of interfacial angles on single crystals) was outlined in his book "Systematic Crystallography" (1930) and reviewed by Spiller and Porter[1] in 1939. It will include all crystals (other than cubic, to which the method is not applicable) in Groth's "Chemische Krystallographie", which was completed in 1918. These number some 7,300. To these may be added the (probably small) number of compounds studied goniometrically since 1918. (2) Data on the refractive indexes of upwards of a thousand substances have been collected by Winchell in "The Optical Properties of Organic Compounds"[2]. (3) The index of X-ray diffraction data[3,4] sponsored by the American Society for Testing Materials and the Institute of Physics covers some 2,500 substances, including those in the supplement now in preparation.

Since the professed object of these indexes is that they will facilitate the identification of unknown substances, they must first be judged from this purely utilitarian point of view. Two questions immediately present themselves, namely, how often is anyone faced with the problem of identifying a solid substance, and how useful are these indexes for the purpose, and/or how useful are they likely to become within a reasonable time? We may assume that problems of identification are likely to be confined almost entirely to industrial or analytical laboratories. Also, something of the chemical nature of the substance will generally be known. Now the number of organic compounds known is of the order of 250,000 and of inorganic compounds probably some 40,000. With the above numbers in view, it is clear that at present the chances of identifying an *unusual* substance with the help of any available index are negligible. In the case of organic compounds, a really comprehensive index is obviously out of the question. Anyone tackling a specific identification problem in a specialized field would be more likely to succeed by taking X-ray photographs of a number of related compounds, particularly as the compound may not have been prepared before. It is also clear that unless the task of expanding these indexes is taken very seriously, more comprehensive compilations including other physical properties would be of greater practical value, assuming always that this problem of identifying unknown substances is sufficiently important to justify the labour involved.

Now although the X-ray index is likely to grow much more rapidly than the other two, it suffers from a grave disadvantage. Certain large groups of compounds, for example, complex oxides and sulphides and alloy systems, are notable for their variable compositions and hence variable lattice constants and intensities of reflexions. This is a serious matter in a classification based on the spacings and intensities of lines on powder photographs. It must be remembered that the X-ray index, being purely a 'fingerprint' system which does not add to our knowledge of any physical constants, must be judged solely on its merits as a means of identification. Before much more time and money are spent on such projects it would seem advisable to consider (*a*) the actual or potential practical value of any index, bearing in mind the points raised above, and (*b*) the most desirable form of index, that is, the nature and arrangement of the data therein.

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[1] *Nature*, 144, 298 (1939).
[2] *Nature*, 154, 349 (1944).
[3] *Nature*, 149, 437 (1942).
[4] *Nature*, 150, 738 (1942).

Hydrogen Overvoltage as a Factor in the Corrosion of Metallic Couples

CONSIDERABLE confusion has been caused in the past by neglect of the influence of the hydrogen overvoltage on the corrosion current between metallic couples in electrolytes.

It would seem that there should be no current flow unless the potential difference on open circuit is greater than the hydrogen overvoltage at the cathode; but that when the potential difference is higher than the overvoltage, the current should depend on the difference between the two.

Work at present in progress confirms this view, and we may quote the case of magnesium alloy and copper in sea water. Copper is far removed from magnesium in the electromotive series and has a fairly low overvoltage. A couple of copper and magnesium alloy should thus give a large corrosion current; this, in fact, has been found to be the case.

By amalgamating the copper with mercury, which has a high overvoltage, and in addition is far from magnesium in the electromotive series, the corrosion current is reduced to a very small value. This value, in fact, is much smaller than that obtained with a magnesium/zinc couple, in spite of the fact that zinc is comparatively close to magnesium in the E.M.F. series.

It may be added that the known effect of surface roughness of the cathode on the overvoltage is found to have the expected effect on the corrosion current

Where ready access of oxygen is possible, the hydrogen overvoltage is accordingly reduced, and the corrosion current is able to reach a higher value in such localities.

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Difference Tones

THE interesting question raised by Prof. F. Allen's letter in *Nature* of July 21 is whether the difference tones he observes are present in the air or whether they exist only in the auditory system of the listener If the loudspeaker to which the two oscillators are connected (whether in series or parallel is only a matter of impedance matching) is strictly linear in its amplitude response, then no combination tones sum or difference, will be produced. The ear, on the other hand, is far from linear in its amplitude response so when two high-pitched tones are heard together the difference tone is often clearly audible while the sum tone may be less easily distinguished or above the limit of audibility, depending on the pitch of the beating tones. However, if the loudspeaker is non linear, combination tones will be physically present in the air nearby and could be detected by a linear tuned sound analyser. If this is not available it should be possible to feel or even see the low frequency vibration of the loudspeaker diaphragm when the two tones are nearly in synchronism.

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Transplantation of the Heart

FOR a number of years, my laboratory has bee studying the problem of transplanting the heart o vertebrate animals. In the animal kingdom man necessary prerequisites exist for carrying out th important, and at first sight impossible, operatio The first stage, 1938–42, was my work on cold blooded animals—frogs and fishes. After a number o experimental variants and the perfection of the operation technique, I succeeded in transplanting to frog a second heart taken from another animal; planted the second heart in the same pericardium as the heart of the host. Animals with two hearts showed no differences from control frogs, and experienced biologists invited to examine them were unable to distinguish one from the other. Two hearted frogs went through the usual nuptial period in spring, and cast their spawn in the ordinary way

As this series of experiments proved successful, then began the next series, the purpose of whic was to replace the heart of a host animal with that of another animal—a much more complicated task. The operative technique required by this series of operations was also more complicated; but after persistent attempts all difficulties were overcome.

In 1943, I removed the heart from a frog and transplanted another heart into the same pericardium. Two or three minutes after the operation, it was impossible to distinguish the operated frog from control specimens. Some of these frogs lived more than a hundred and ninety days, which is more than six months, and their behaviour did not in any way deviate from normal. In the spring of 1944, they went through a nuptial period which also ended in casting spawn.

Six months later, microscopic examination of blood vessels that had been sewn together showed that hey had knitted completely, and that the structure of the heart muscles was normal.

When there are two hearts beating in the breast of one frog, they have entirely different relations to he animal organism. The host's own heart has both neural and humoral connexions with its organism hrough blood, while for the first thirty-five–forty days the transplanted heart has only humoral chemical connexions; the nerves of the host then begin to grow on to the transplanted heart.

It is also possible to study the action of a number of cardiac medicaments on organisms with two hearts. There is undoubted interest in the question of the length of time taken by the transplanted heart o take root in the host's organism, when the host's nerves grow on to it, and what happens to nerve ganglions inside the heart.

The success of these experiments on cold-blooded animals led me to repeat the experiments on rabbits, ats and dogs. As a preliminary measure, we carefully developed methods of joining the blood vessels of warm-blooded animals; the method we developed s exceedingly simple and rapid—it takes twenty to thirty seconds to perform.

In the first series of these experiments, we developed methods of transplanting the heart into the necks of these animals. In this series of experiments, the second heart had only its right half joined nto the host's blood circulatory system. The left half of the heart was not 'in circuit'. This system we called the 'semiclinical' method.

Observations showed that the heart worked well nd would live for a long time. The heart retained s own rhythm and had no adverse effect on the lood pressure of the host or its ability to perform work.

For the second series of experiments, after a long earch for the correct method, we transplanted hearts nto the necks of hosts with both halves, arterial nd venous, in circuit with the blood circulatory ystem. This gave us a complete second heart, 'clinical ansplantation', as we called it.

Animals on which we experimented—rabbits, cats nd dogs—easily withstood the operation with very mall loss of blood and without any visible effect n the work of their own hearts.

Operated animals did not show any shortness of reath, spasms or excessive excitation after operation. They reacted normally to all external exciting gents, such as light, sound and pain.

Transplanted hearts retained their own individual hythm, which as a rule is slower than that of the ost's heart.

A method has been developed for the simultaneous registration on a kymograph of the work of both hearts. This is a valuable method of studying various theoretical problems of heart treatment, humoral and neurohumoral, in warm-blooded animals with two hearts.

After having mastered the transplantation of a second 'clinical' heart in warm-blooded animals, my laboratory is now carrying out long-term experiments for the purposes of keeping animals with two hearts alive as long as possible. Simultaneously, we are conducting experiments on the transplantation of hearts into the abdomen.

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Behaviour of the Common Centipede *Lithobius forficatus*

ALTHOUGH the Chilopoda are a widely distributed order, they have attracted little notice from zoologists. Centipedes are carnivorous, feeding on insects and their larvæ, and occasionally worms and other small animals. The account by F. G. Sinclair in "The Cambridge Natural History" (1895) is still the most comprehensive survey of the group; but recent observations are at variance on certain points. Sinclair describes the breeding habits of *Lithobius forficatus*, and states: "If the male Lithobius sees the egg, he makes a rush at the female, seizes the egg and at once devours it". No reference is made as to the manner in which centipedes recognize their food, but it is implied that the sense of sight is used. Now *Lithobius* is almost invariably nocturnal, and can only be found in day-time underneath stones and piles of dead leaves. That it is negatively phototactic and positively thigmotactic has been confirmed by simple experiments. The eyes are clusters of ocelli, 25–50 in number, present in many groups of Lithobiidæ but absent in some. It would appear unlikely that the sense of sight is used in the recognition of food, and indeed, this has been proved experimentally by painting the eyes with black pigment. Nor is the sense of smell employed. Experimental observations indicate that *Lithobius* hunts for its prey by the sense of touch, which is extremely sensitive. Centipedes appear oblivious to the presence of food unless they happen to touch it with the base of the antenna.

In this connexion, the following extract from the section on "The Scolopendra and the Galley Worm" in Buffon's "Natural History" published January 31, 1782, is of interest: "Of theſe hideous and angry inſects we know little except the figure and the noxious qualities . . . they are covered with hair, and ſeem to have no eyes; but there are two feelers on the head, which they make uſe of to find out the way they are to paſs. . . ." The antennæ are covered with sensory hairs, and are continually cleaned with the maxillæ. The legs are periodically cleaned in the same manner, but less frequently. Removal of the antennæ renders the animals powerless to avoid obstacles; but they may blunder into and eat dead flies, etc., placed in their cage.

Centipedes can live for many weeks without food provided that they are kept in a damp environment. Cannibalism becomes apparent if one of the animals is particularly small or has been injured. After killing its prey, *Lithobius* seeks a soft spot by prodding with the poison claws; grips firmly with the 2nd maxillæ (sometimes assisted by the poison claws) and gnaws with the mandibles, the muscles of which can be observed through the integument of the head. I have often observed one *Lithobius* snatch at a dead fly being eaten by another centipede. If the attempted robbery proves unsuccessful, the robber may give the other a sharp, but not fatal, nip with the poison claws (maxillipeds) to make it drop its prey. Occasionally two centipedes are to be seen feeding on the same insect.

Lithobius can survive several hours immersion in water. At first it struggles violently, sometimes swimming (like *Nereis*) by a series of rapid flexions; but its motions soon become sluggish. Centipedes become darker when placed in dry surroundings than in a damp environment. This colour change is not affected by light, adrenaline, etc.; it also occurs in dead centipedes and is probably a physical change in the integument.

In conclusion, it can be stated that, except the eyes, which do not appear to be of much importance, the sense organs of *Lithobius forficatus* are in the form of hairs, or groups of hairs, each fitting into a cup in the cuticle, and connected with nerve fibres. In consequence, the behaviour of the animal is (with the exception of negative phototaxis which occurs even when the eyes are covered) chiefly governed by reactions to thigmotactic stimuli.

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July 21.

Hatching of the Egg of *Ixodes ricinus* L.

The mechanism of hatching in the sheep tick does not seem to have been previously described. When freely laid, the eggs are oval, but deposition in crevices results in a certain amount of flattening. Examination of the egg under the microscope reveals that the brown colour is due to a thin semi-transparent shell, covering the brown internal mass. Each egg is surrounded by a gelatinous secretion produced by Gené's organ. Immediately after oviposition, the individual egg weighs 0·00006 gm.

The pre-oviposition period varies with the season and with the individual, but usually lasts 15–22 days[1]. Prior to hatching, the larva shows very little activity, and the density of the internal contents precludes any detailed observations upon it. Twenty-one to thirty days after oviposition, at 60° F., and a relative humidity of 80, the eggs show an extensive white area of an abbreviated dumb-bell shape, surrounded by the yolk. During the forty-eight hours before emergence, the body of the arachnid comes to fill the egg more completely; the yolky contents of the gut become apparent, with small interspersed fat globules. Occasionally rhythmic movements of the head are obvious. It is suggested that at this period the larva swallows the amniotic fluid in much the same way as insects do[2]. When this fluid is added to the fatty contents of the gut, the fat globules run together to form large droplets.

At this stage the larva is enclosed in a membrane, the first or 'embryonic' cuticle, which surrounds each limb in an unsegmented sac; but in view of its smallness the limbs are very much crumpled. The head is flexed ventrally and is not visible from the dorsal aspect. Viewed ventrally, the appendages a closely apposed to one another and to the bod generally.

Within twenty-four hours of hatching, the outwar form of the egg is changed, becoming longer an thinner. Air enters the egg shell and occasionall some air may be swallowed by the larva. This, how ever, is not constant and seems to play no essenti part in the process of hatching. The enclosed larv extends the posterior part of the body and ruptur the egg shell longitudinally. It is believed that th rupture of the egg shell follows a distinct line weakness, as similar cleavages have been obtaine by the treatment of newly deposited eggs wit dilute and concentrated acids.

No air appears to be swallowed after hatchin The posterior end of the body invariably emerg first and the anterior portion of the body may b retained for some hours within the egg shell. Ulti ately, by slow movements of the legs, the entire bod comes out of the shell and the larva crawls som distance from the remains. At this stage the hea is still reflexed, of a very pale almost transpare character, and the legs but lightly sclerotized. Th tick remains quiescent with its legs drawn close to the side and head reflexed for 7–10 days at 60° and relative humidity of 80 per cent.

A fuller report on this investigation will be presente elsewhere.

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[1] MacLeod, J., *Parasitology*, 27, 489 (1935).

[2] Sikes, E. K., and Wigglesworth, V. B., *Quart. J. Micr. Sci.*, 74, 1 (1931).

Control of Foot Rot (*Phoma* sp.) of Fla

With regard to the reference[1] made to the use 'New Improved Ceresan' for the prevention of fo rot (*Phoma* sp.) of flax, further experimental wo has given the following results. Seed with a moistu content below 10 per cent and treated with this di infectant at the rate of 12 oz. per cwt. showed adverse effect of the treatment on germination wh kept for 18 weeks in hundredweight lots und ordinary storage conditions. Tests made with see on porous dishes placed on damp sand showed th the germination of treated seeds was 75 per cent compared with 95 per cent in the case of the u treated. This adverse effect was also apparent wh seeds were sown in soil in the greenhouse. No effe on germination was observed when the seed had be stored for 8 weeks. Seed from the same lot as t above but treated with 'Arasan' at the rate of 12 per cwt. and stored for 18 weeks under similar co ditions showed no reduction in germination.

When seed having a moisture content of 14 cent was treated with 'New Improved Ceresan' the rate of 12 oz. per cwt. and tests made within days, it was found that the germination was reduc from 65 per cent in the untreated seed to 46 per ce in the treated. It should also be stated that in t case of the treated sample an additional 23 per ce of the seeds showed abnormal growth on germinati The damage caused by treating damp seed has a been demonstrated by sowing seed in soil.

It would therefore appear to be inadvisable treat flax seed with 'New Improved Ceresan' if t ed has a moisture content greater than 10 per cent. n the case of seed with a moisture content less than 0 per cent, and where 'New Improved Ceresan' is sed, a period of not more than eight weeks under ood storage conditions should be allowed to elapse etween treating and sowing.

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[1] Muskett, A. E., and Colhoun, J., *Nature*, 155, 367 (1945).

Nature, Nurture and Probability

SINCE Galton, it is customary to consider that aracters are due to nature or to nurture, or to oth, and that there is no third cause. From a ractical point of view, however, factors of chance n surely be supposed to play a part. To clarify is conception, let me take an example.

A malignant tumour is caused by some single cell r group of cells reverting to the fœtal stage and viding afresh. If this is due to hereditary factors, e should expect a general tendency in the cells of a iven tissue towards malignity. In that case, cancer ould appear concurrently at several places. This is ot so, however, which is why it is possible to treat ncer operatively. The same holds for the external vironment. If this environment caused a tumour arise, we should also as a rule expect an extensive rmation of tumours. It is difficult to imagine vironmental factors with an action on a single oint.

But there is a third possibility. Let us assume a ereditary disposition to cancer, entailing a tendency wards faulty behaviour of a certain type among e cells, for example, in cell division. Let us further sume that the hereditary tendency towards such ulty behaviour is extremely weak, and that on is account there is, for example, a 1 : 30 probability at an individual may be overtaken by such de- ction each year when he gets older. This means at, among the extremely large number of cells esent, and the very large number of cell divisions process, the probability for each cell to become a ncer cell is diminutive. If we reckon per individual stead of per cell, the tendency becomes much eater. If it is 1 : 30 a year, this implies that one of pair of monozygotic twins might get cancer relatively rly, while the other would not get it until 30–40 ars later. In most cases, then, the second twin in irs of this kind should die from a disease other an cancer. The difference between monozygotic d dizygotic twins in respect of the occurrence of ncer should therefore be very small. This being , studies on twins cannot be used to determine e part played by nature and nurture.

The situation can be illustrated by an analogy, ich must not, however, be taken too far. Let us sume that, in two large towns, the population has actly the same heredity and lives in the same vironment. Let us assume further that this results a great infrequency of suicide, so that the prob- ility for such an act in any one year is 1 : 30. a suicide then occurs in one of the two towns ring any given year, it may be many years before suicide occurs in the other town.

The conception of probability is therefore used at several different points in genetics, primarily in the distribution of the genes over the sex cells, and in their combination, secondly in genotypical asymmetries[1], and finally in certain other characters, where internal processes of a complicated nature are in process. The formation of cancer is an example of this. Similar conditions can also be thought to play a part in mental characters. From this point of view, the result of twin research in mental diseases may appear to some extent doubtful, since when processes of the kind touched on here are involved, the differences between monozygotic twins will be relatively large, and can by no means be taken as a gauge of the influence exerted by external environment.

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Aug. 9.

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[1] Dahlberg, G., *Proc. Roy. Soc. Edin.*, B, 62, 20 (1943).

A Forecast of Solar Activity

I WISH to direct attention to the fact that a relatively long period of intensive solar activity seems to be imminent. If this should be the case, the coming years will probably be very suitable for studying possible relations between sunspots and such terrestrial phenomena as are supposed to be allied to solar activity.

While exact predictions of the future course of sunspot numbers are impossible, forecasts with a high degree of probability can be derived from the probability laws of sunspot variations which I have published[1]. These forecasts may be summarized as regards the present new spot cycle as follows:

(1) It can be expected with a probability of 0·95 that the next sunspot maximum will be higher than the previous one, which occurred in 1937. It may be noticed that the height of the maximum of 1937 itself exceeded the heights of the five preceding maxima, which occurred in 1883, 1894, 1906–7, 1917 and 1928. Hence it seems very probable that the next maximum will be the greatest within living memory.

(2) It can be expected with a probability of 0·95 that the next sunspot maximum will occur before May 1948. At the meeting of Section D (Astronomy) of the American Association for the Advancement of Science held on September 14, 1944, S. B. Nicholson, of Mt. Wilson Observatory, reported that solar activity reached its last minimum as late as in April 1944; thus it follows from (1) and (2) that in the new spot cycle the ascent from minimum to maximum will probably be unusually steep.

(3) It can be expected with a probability of 0·98 that after the next maximum, solar activity will decrease so slowly that not until more than five years after this maximum will Wolf's smoothed sunspot numbers fall below a quarter of their maximum value. Such a slow decline has occurred in only four out of the seventeen spot cycles which have been observed hitherto.

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July 11.

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[1] *Astrophys. J.*, 96, No. 2 (Sept. 1942).

YEAST HEXOKINASE AND ITS SUBSTRATES *d*-FRUCTOFURANOSE AND *d*-GLUCOSE

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On solution in water, *beta d*-fructopyranose, the only crystalline form of *d*-fructose, exhibits mutarotation which mainly consists in a pyranose $\rightleftharpoons$ furanose interconversion[1,2]. In experiments at 0° C. and $pH = 4 \cdot 5$, under which conditions mutarotation proceeds the slowest, it was previously[3] shown that *beta d*-fructopyranose added to a suspension of baker's yeast in 0·1 *M* KH_2PO_4 is unfermentable, whereas *alpha d*-glucose is fermented at the expected rate. Since in any quantitative consideration of the composition of a *d*-fructose solution at equilibrium ($pH = 4 \cdot 5$) open-chain forms (keto-form, enol-form) can be neglected, *d*-fructofuranose, chiefly present in the *beta* configuration, remains as the only fermentable isomer. The non-fermentability of *d*-fructopyranose—obviously due to lack of an OH-group at C_5—rendered possible the determination of the proportion of the furanose form in an equilibrium mixture of *d*-fructose at 0° C.; this proportion was found[4] to be 12 per cent. From this figure and the known differences in mutarotation of *d*-fructopyranose at 0° C. and at 25° C., it can be calculated that an equilibrated *d*-fructose solution at 25° C. contains approximately 22 per cent of the sugar in the furanose modification; it is in this way that the concentrations of fructofuranose given in this report have been derived.

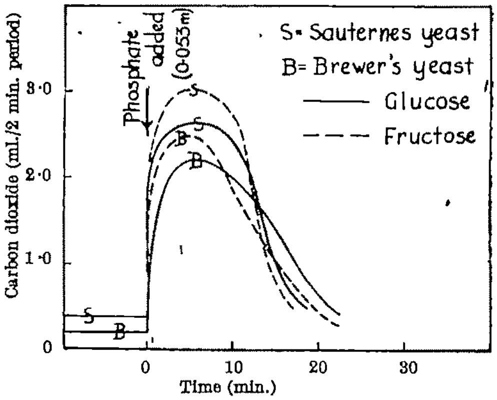
Recent experiments with sucrose as fermentation substrate have justified the aforementioned conclusion, thus confirming a hypothesis first advanced by Hopkins[5]: 0·002 *M* sucrose in phosphate solution ($pH = 4 \cdot 5$) was fermented by baker's yeast at 0° C. with conditions so arranged that 50 per cent of the disaccharide added was already inverted within 70–80 sec. It was found that after fermentation periods of 20 or 40 minutes, approximately equal amounts of *d*-glucose and *d*-fructose are left, in contrast to the preponderance of *d*-fructose in the residual aldehyde-ketose mixture when sucrose is fermented at 25° C.

With *Sacch. cerevisiæ* (brewer's top and bottom yeast, distiller's yeast) the ratio of the maximum velocities of the separate fermentations of *d*-fructofuranose and of *d*-glucose at 25° C. is 1·05[6]. It is, however, well known that Sauternes yeast ferments fructose much faster than glucose at any concentration[5,7]. It can be seen from the table that at 25° C. Sauternes yeast ferments 0·019 *M* fructofuranose at a rate 72 per cent greater than that at which it ferments 0·055 *M* glucose; at these concentrations both sugars are fermented by brewery bottom yeast at the same rate. These figures were recently obtained with a pure culture of Sauternes yeast which Pr R. H. Hopkins, University of Birmingham, kind procured for me from the Institut Pasteur, Paris.

Relative rates of fermentation by living Sauternes and brewer's yeast in 0·05 *M* KH_2PO_4 at 25° C. (gas phase: nitrogen).

	0·055 *M* Glucose	0·019 *M* Fructofuranose	0·252 *M* Glucose	0·446 *M* Glucose	0 041 *M* Fructofuranose
Sauternes yeast	58	100	64	64	96
Brewer's yeast	88	88	100	100	100

These differences between brewer's and Sautern yeasts in their behaviour towards the aldehyde a the keto sugar disappear completely when dri preparations of the yeasts are used. The curves the accompanying figure show that at 0·053 *M* initi phosphate concentration both with dried brewe and with dried Sauternes yeasts the ratio of t maximum fermentation rates of fructofurano (0·05 *M*) and of glucose (0·40 *M*) is approximately 1·



Rates of fermentation of glucose (0·40 *M*) and of fructofuranose (0·05 *M*) by dried brewer's and Sauternes yeasts (1 gm.) at 0 053 *M* initial orthophosphate concentration. All samples contain 3 mgm. acetaldehyde and 0 8 ml. toluene. Total volume, 10·6 ml. $pH = 6 \cdot 2$. Gas phase: carbon dioxide. Temp. 25° C.

With inorganic phosphate and sugar concentratio high enough to provide optimal conditions for t reaction: 3-phosphoglyceraldehyde + phosphate cozymaze $\rightleftharpoons$ 1,3-diphosphoglyceric acid + dihydr cozymase, the small difference in the maximum rat of fructofuranose and of glucose fermentation dried yeast preparations is probably due to differe rates of the hexokinase reaction with fructofurano and with glucose. It would appear that in the presen of excess substrate the turnover of the phosphoryl tion of fructofuranose by hexokinase is about 10 p cent greater than that of glucose. The greater activity of fructofuranose with hexokinase reve itself most noticeably at low concentrations of t substrate. Thus using dried brewery yeast a 0·081 *M* phosphate concentration, with fruct furanose half the maximum velocity was attained 3×10^{-3} *M* concentration, as compared with gluco at $7 \cdot 2 \times 10^{-3}$ *M* concentration. This is in clo agreement with the results of previous measuremen showing that the ratio of the dissociation constant the hexokinase-glucose complex to that of the hex kinase fructofuranose complex is approximately 2.

These results allow of a common interpretation the initial step in alcoholic fermentation of *d*-gluc and *d*-fructose by different types of yeast, which w previously scarcely possible[6,7,5,6]. In view of t close approach of the maximum rates of fermen tion by dried Sauternes yeast of fructofuranose a of glucose (in higher concentrations) the differen in those rates exhibited by living Sauternes yeast best explained as due to differences in the permeabil of the membrane of the living cell for the two suga The same enzyme, hexokinase, is concerned in t primary attack on *d*-fructose and *d*-glucose irresp tive of the type of yeast. A marked difference, ho er, exists in the interaction between hexokinase d the two substrates. While all the components of *d*-glucose solution at equilibrium react with hexo- nase, of the various *d*-fructose modifications only at fraction present in the furanose form serves as bstrate. This very reactive and labile substance s about twice the affinity of glucose for hexo- nase. If fructofuranose and glucose compete for xokinase, as they do in the fermentation of invert- gar, the relative rates of disappearance of fructose d glucose from the medium depend on the relative ncentrations of fructofuranose and of glucose inside e cell and their relative affinities for the common zyme. While at room temperature with brewery d baker's yeasts the much higher concentration of e aldehyde sugar within the cell outweighs the eater affinity of fructofuranose for hexokinase elective fermentation of glucose'), in the case of uternes yeast the greater permeability of the cell embrane of this yeast for fructofuranose plus the gher affinity of this sugar for hexokinase result in e 'selective fermentation of fructose'.

It seems to be noteworthy that *d*-fructose, when king part in the biological formation of fructose-6- osphate, fructose-1,6-diphosphate, aldosido < > ctosides and polyfructosides, always reacts in the bile furanose form. This may suggest an interpreta- n of the central role assigned to *d*-fructose in the etabolism of carbohydrates.

Full details will be presented elsewhere, including more complete survey of the literature.

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MELLON INSTITUTE OF INDUSTRIAL RESEARCH

ANNUAL REPORT

HE thirty-second annual report of the director, Dr. E. R. Weidlein, to the trustees of the Mellon titute of Industrial Research, Pittsburgh, Pa., ers the year ending February 28, 1944, and the rd year of war research at the Institute. Research l advisory collaboration with the War and Navy partments grew in scope and value during 1944–45, well as investigations and other technical help the War Production Board, Rubber Reserve npany, National Defence Research Committee the War Metallurgy Committee of the National demy of Sciences. During the year in question, ety-four industrial research programmes were in ration, of which fifty-four were multiple fellow- s ; this does not include seven fellowships the vities of which stopped for the duration of the r. Of the ninety-four fellowships, three have n proceeding for thirty years and four others for nty-five years ; twenty-two have been proceeding more than ten years, and twenty-seven have been peration for five years. During the year 1943–44, Institute's expenditure for pure and applied arch amounted to 2,042,385 dollars ; 244 fellows were employed, together with 232 research associates and assistants, laboratory assistants and technicians.

From the long list of investigations mentioned in the report it is possible to select only a few for mention. In the physical field an investigation has shown the potential speed of a process for separating gas mixtures by diffusion into a fast streaming vapour. Methods for measuring surface areas of porous adsorbents have been studied critically and a method published for determining thermal conductivities at low temperatures. An investigation on frictional losses in vaned elbows of asbestos ducts has led to these losses being reduced to an absolute minimum. Research on the treatment of dry air-set mortars so as to prolong the period during which they may be stored has led to products which may be stored about four times as long as the present material, and the manufacture of products such as 'Garcrets', 'Garspar', and 'Gartex' has been improved in efficiency. A new process devised for the manufacture of 'Garsand', a promising glass batch ingredient, will form the basis of an extended programme. A combination limestone-lime process which offers substantial saving in many localities has been developed for treating waste pickle liquor, and current investigation indicates that magnetic iron oxide of pigment quality can be obtained from waste pickle liquor by a simple process with low operating costs.

A study of the impurities in nitration benzene indicated that the principal contaminants are naphthenes, some of which have boiling points as much as 20° above that of benzene. A rapid and accurate method has been developed for determining hydrogen cyanide and its derivatives in the gaseous, liquid or solid state, as well as a new process for making guanidine nitrate. Investigations on the rheological properties of tar products have led to the manufacture and introduction of a pitch compound of modified flow characteristics, suitable for protecting metal products such as corrugated roofing and siding, flat and V-crimp sheets and associated constructional accessories. A process has been discovered for vinylnaphthalene, which has promise in plastic technology, and progress has been made in the synthesis of picolines and vinyl derivatives of pyridine and in the oxidation of lutidine and picolines. The synthesis and properties of 1 : 1 : 3-trimethylcyclopentane, a new hydrocarbon, have been described. The identification of some fifty alkylated phenols, based on the properties and X-ray diffraction spectra of their phenyl *iso*cyanate derivatives, has been published. Much attention has been given to the development of improved synthetic lubricants for aircraft instruments, and a high-quality product has been developed. Lubricating oils for watches and similar fine mechanisms are also being investigated, as well as the production of chemicals for improving hydraulic fluids and low-temperature lubricants for the Armed Forces, while collaborative testing of extreme pressure addition agents has been carried out for a Government agency.

A study of the proteolytic enzyme activity in chicken eggs has been concluded and an economic process for drying yeast will soon be in operation. Fundamental advances have been made in the programme on cotton properties, and other investigations in the textile field have covered sizes for knitted hosiery, resin coating for fibres, and new treatments of woollen felts against heat, water, chemicals and abrasion.

Special reference is made in the report to the investigations of the Department of Research in Pure Chemistry on the synthesis of new anti-malarials, particularly the application of the novel hydroxyethylating agents, and a hydroxyethyl analogue of 'Pamaquin' has shown considerable promise. Sulphur derivatives of quinoline have also been prepared, as well as ten new bases of 2-styrylquinoline type in which a modification of Brahmachari's method raised the yield from 2·5 per cent to 80 per cent. Conditions have also been established for the formation of the *p*-dialkylaminobenzylidene diquinaldines, and four new 4-*p*-dialkylaminostyryl-quinolines have also been prepared as well as 6-hydroxyethoxylepidine and the corresponding 6-hydroxy derivatives. The pharmacological properties of the hydroxyethyl-ether derivative of morphine have been determined, and an intensive search made for morphine derivatives free from the medically undesirable side-effects and less liable to cause addiction. The Institute is also participating in the thirteenth revision of the Pharmacopeia of the United States, which is now under way.

Studies of the physical and chemical properties of synthetic racemic menthol have been published, and a method developed for determining iodine in organic compounds. The Institute is also co-operating in an important investigation of chemical methods of analysis for the highly insoluble glass required for ampoules for penicillin and organic arsenicals.

A RADIO NAVIGATIONAL AID

A NOVEL method of position-finding by the aid of long radio waves, applicable to both aerial and marine navigation, has been developed to practical utility during the War by the Decca Record Co., Ltd.

The system uses two or more fixed transmitting stations which radiate signals of constant frequency and amplitude in all directions along the ground. At the receiving point the difference in phase of the waves arriving from two stations is measured, and it is then known that the receiver is on one of a number of hyperbolic curves, which are the loci of points of equal phase difference from the two transmitters. By repeating the observation on the signals from a third station compared with one of the first two, the position on an intersecting series of curves is found, and so the exact location of the receiver is determined. The phase comparison must be carried out on signals of identical frequency, but since only signals of different frequency can be received separately, the transmitting stations operate on different frequencies having a common harmonic relationship, and the necessary restoration to a common frequency for measurement purposes is carried out in the receiver itself.

In the development of the Decca Navigator system, great care has been taken to secure adequate frequency control of the transmitters and also of the reference oscillator in the receiver, which has been designed around radio circuits of high stability. The actual measurement of phase is carried out with a special meter which, by means of a train of gears and suitable indicators, displays a direct reading of the phase difference for transfer to the chart supplied for use with the instrument. Various precautions have been taken to render the whole system free from variations of phase of the signals due to instr mental changes, and the sites of the transmitti stations are selected so as to avoid so far as possib any effect of varying ground conditions on the pro agation of the radio waves used. It is claimed th at a range of 300 miles, the navigating system accurate to about 200 yards, and for shorter rang it is more accurate still. Much greater ranges a possible for daylight working, but during the nig the effect of ionospheric waves superimposed up the ground waves may limit the range at which t highest accuracy can be obtained.

During the War the system was used by t Admiralty; and it has now been disclosed that was used from *D*-day onwards to guide the leadi minesweepers and landing flotillas. The system likely to have peace-time applications to both and marine navigation.

EXCHANGES OF INORGANIC ION THROUGH LIVING MEMBRANES

THE large differences in concentration of sing ions (especially potassium and sodium) betwe living cells and their surroundings were discussed the Croonian Lecture of the Royal Society*. The differences are generally maintained by transp work through the surface layer making good t simultaneous diffusion losses.

Membranes differ greatly in permeability as sho by selected examples. The blood vessels of the ver brate central nervous system in particular show ch acteristics of permeability approaching those of t surfaces of many cells. They are highly permea to water and lipoid-soluble substances, but o slightly permeable to crystalloids including ions.

A number of examples were given demonstrati the active transport of ions through membranes co posed of cells (plant roots, gills of aquatic anima intestinal epithelium, etc.) and into (or out individual cells (giant plant cells, root cells, eryth cytes, striated muscles, etc.). All the cells stud are freely permeable to water, but the differe between mechanically supported plant cells and na animal protoplasts was emphasized. The latter m always be in osmotic equilibrium with their roundings, while the former can build up a surp pressure by active absorption of ions.

In the case of plant roots, the energy expended absorbing anions is considerable; but in animal c the permeability is so slight that the energy exchan involved in active transport cannot be measur In several cases the process depends upon the acc to glucose or oxygen or both.

In cases where an active transport takes pl the passive permeability can only be measured means of isotopes and only when special conditi are maintained. Several experiments with isoto have been recalculated to give absolute permeabi figures, and these show for erythrocytes and mus higher values for sodium than for potassium, a re incompatible with a simple pore permeability, supporting the Lundegårdh conception of mo surface films of the Langmuir pattern.

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* Abstract of the Croonian Lecture "The Active and Pa Exchanges of Inorganic Ions through the Surfaces of Living and through Living Membranes Generally", delivered by Prof Au Krogh, For Mem.R S, before the Royal Society on October 25. Lecture should have been given in 1940, but Prof. Krogh was unable to travel to England.

COSMIC RAYS

ANGLO-FRENCH CONFERENCE IN BRISTOL

AN Anglo-French Conference on cosmic rays was organized by the Physics Department of the niversity of Bristol, with the collaboration of the ritish Council and of the French Government, hich made it possible for about fifteen delegates om Paris and other French universities to attend. he discussions took place in the H. H. Wills Physical aboratory during September 25–27, and were tended by about sixty physicists, including Prof. F. oliot, Mme. Joliot-Curie, Dr. P. Auger, Prof. P. A. M. irac, Prof. P. M. S. Blackett and Sir George Thomon. The conference was the fourth in the series of ternational physics conferences in Bristol—others ere held in 1935, 1937, 1939—and was one of the rst international gatherings of its kind since the War.

The conference was devoted mainly to discussions n cosmic rays and certain aspects of nuclear physics. n his opening remarks, Prof. N. F. Mott, after weloming the French delegation, stressed the importance f such conferences, and expressed the hope that others f a similar character would follow. They would onstitute an important contribution to re-establishg that international collaboration between scientific orkers which has been so seriously hampered by e War and is of such decisive importance for the lvancement of knowledge and understanding beween peoples. During the past five years the work both French and British men of science has been rgely interrupted by the German occupation of rance and, in Britain, by preoccupation with shortrm war-like applications; the main object of the nference was thus to survey rather broadly the resent position in our knowledge of the cosmic rays, d to exchange views on the main problems awaiting lution.

In introducing the discussion on the cosmic rays, rof. P. M. S. Blackett pointed out the importance a clear recognition of the difficulties encountered y the present theories of nuclear forces and of highergy particles. He said that in this field at the oment theoretical physicists are very experimental their search for a satisfactory formalism, and that til some of the major difficulties have been resolved, perimenters should avoid attaching too much eight to theoretical conclusions.

In a review of researches on cosmic rays carried t during the War, Dr. L. Jánossy said that at sea-vel the cosmic radiation consists of at least three mponents; the soft component consisting of posive and negative electrons, the hard penetrating mponent of mesons and a very penetrating comnent of low intensity consisting probably of prons and neutrons. The mesons must be of secondary igin because of the short mean life-time, 2×10^{-6} c., between their formation and disappearance with e emission of a fast electron.

Wataghin and his co-workers, and, independently, nossy and Engelby, have established the existence showers containing several penetrating particles. e air-lead transition of such showers has also been vestigated by Jánossy, and the effects observed n be interpreted as due to the production of mesons the impact of fast protons and neutrons on the d nuclei. The magnitude of the effect and other tures of the observations are in satisfactory agreent with the theory of Hamilton, Heitler and Peng.

In a paper on the meson theory, Prof. W. Heitler pointed out that the short-range forces between the nucleons, that is, the neutrons and protons, which are responsible for the fact that the ordinary nuclei are stable structures, can be explained only in terms of a new kind of field, the meson field. Each nucleon is regarded as being surrounded by a meson field analogous to the electromagnetic field in the case of charged particles. In the meson field theory, the mesons, first postulated by Yukawa, are analogous to the quanta of the electromagnetic field theory, but are distinguished in that they may be charged, positively or negatively; that they have a finite rest-mass and a short life-time. Just as in the case of the hydrogen molecule the cohesion of the two component atoms is due to the exchange of electrons between them, the so-called exchange force, so the force between two nucleons is to be attributed to the exchange of mesons between them.

In the development of the meson theory the interaction between mesons and nucleons was first treated in a way analogous to the interaction between electrons and radiation. The results so obtained were, however, in sharp disagreement with the cosmic ray observations. The discrepancy appears to be due to a neglect of terms corresponding to radiation damping. In the electromagnetic case, in treating the interaction between an electron and an electromagnetic field, this term is very small and can be ignored. On the contrary, it appears to be of great importance in the meson theory. Hamilton, Heitler and Peng succeeded in developing a method of taking account of the radiation damping term, and thus obtained reasonable values for the cross-section for processes involving the collisions between mesons and nuclei. In particular, a large body of experimental facts can be accounted for in terms of the emission of mesons in the collisions between nucleons. In this way a satisfactory picture of the main features of the hard component of the cosmic radiation can be drawn, if we assume that the primary particles entering the high atmosphere are protons and neutrons, which soon collide with nuclei and thus generate fast penetrating mesons. The soft component consists of electrons produced by photons in the well-known cascade process involving pair production, but the relation between the soft component and the primary particles is not yet clearly established. The agreement between the theory and the experimental observations on the hard component is remarkably satisfactory when it is considered that the necessary constants in the theory are not arbitrary but have been determined from nuclear parameters by Möller and Rosenfeld.

A. Rogozinsky described experiments to demonstrate the existence of mesons in the extensive Auger showers. Certain of the showers were shown to contain a single penetrating particle. During the discussion, photographs were shown of the end of the track of mesons and the fast electron emitted in their decay, as obtained with the high-pressure expansion chamber developed by the late Prof. E. J. Williams. M. Tsien also showed a scientific curiosity in the form of an expansion chamber photograph obtained by Dr. Ho, a young Chinese colleague. The photograph, taken in a magnetic field, shows a positive electron colliding with an ordinary electron without annihilation in the process; the positron recoils, having given most of its energy to the recoiling negatron. Papers on the height of formation of mesons by A. Fréon, and on the measurement of the mean life-time of mesons by M. Maze, were also given. It is found, on the basis of reasonable assumptions about the energy distribution of the mesons created by an initially isotropic primary radiation, that the height of formation of the mesons observed at sea-level is considerably lower than that point in the atmosphere where the meson component has its greatest intensity. This indicates that the observed mesons have been created at a considerable depth in the atmosphere. The observations of the mean life-time of the mesons obtained by M. Maze is in satisfactory agreement with the work of other observers. The hypothesis of a multiplicity of mesons of different mass seems to be unnecessary.

The discussion on various aspects of nuclear physics was introduced by Mme. Joliot-Curie. By an extension of the methods of Bohr and Wheeler, and using recent experimental values for the mass defects, the stability of isobaric nuclei can be studied in some detail. It is possible to determine from the resulting curves whether the elements formed in the fission process, which give rise to the succession of β-emitting bodies, have an odd or an even mass number. The method also gives valuable information about the energy of the resulting continuous β-ray spectrum.

A review of the present stage of development of the photographic method of making visible the tracks of heavy ionizing particles was given by Dr. C. F. Powell. Suitable emulsions are able to record slow mesons as well as protons, deuterons, α-particles and heavily ionizing nuclear fragments. The energy of homogeneous groups of protons and deuterons can be determined, in the absence of serious background fog due to γ-rays, with an error of the order of ± 30 ekv., but the energy of an individual particle is subject to errors of ± 0·3 Mev. In the case of fast protons the orientation in the emulsion of the original direction of motion of the particle can be determined with an accuracy of about 1°.

Some typical results to show the precision obtained with the method were displayed, including measurements on the scattering of fast neutrons by protons and on the angular distribution of the particles resulting from the bombardment of gas targets of the light elements by beams of fast protons and deuterons from the Liverpool cyclotron. The main technical problem remaining to be solved is the improvement in the quality of the emulsions to make possible the employment of unskilled observers in the microscopic examination of the plates.

M. Frilley described experiments on the determination of the wave-length of γ-rays, with especial reference to nuclei of the actinium family, which showed that there are a number of anomalies in the internal conversion coefficients. It has long been known that certain radiations are almost totally internally converted so that they appear with vanishingly small intensity. Frilley showed that the contrary effect also exists in the case of certain γ-ray lines, which appear to produce practically no secondary electrons from the parent atom. No satisfactory theoretical explanation of this phenomena appears to have been found. Other anomalies also occur in the X-ray spectra excited in the radioactive elements during disintegration and studied by different methods. Whereas the differences $K\alpha_1 - K\alpha_2$ correspond well with our general conceptions derived from X-ray spectrography, the corresponding energy differences as deduced from measurements on the internally converted electrons indicate a bigger energy interval.

In experiments on the γ-rays from radium D Tsien, by measuring the ranges of the photo-electron produced in the Wilson chamber, has found a radiation of 23·3 ekv. which is equal to half that of th well-known line at 46·7 ekv. The new line is thu partially masked by the second order of the mai line in diffraction measurements. He also finds radiation of 7 kev. which is of lower energy than tha of the natural L radiation. Tsien stated that i the cases where one finds abnormally high intensitie of the L lines, as in the case of actinium and radiun D, this is probably associated with the interaction o the low-energy nuclear electrons (< 20 kev.) wit the L shell of the atom in question.

J. Surugue described experiments on the study o the secondary β-rays from the actinium family whic is complementary to the work of Frilley on the γ-ray

Lecoin mentioned that certain trajectories of primary electrons from radium E show abnormally hig scattering. Further experimental work on this subject is in progress.

A paper on nuclear isomerism by R. Berthelc dealt with a continuation of Pontecorvo's work o Br^{80}. The metastable level of Br has a period 4·5 hr. The transition to the ground-level is accompanied by the emission of a quantum of energy 49 kev which is completely converted internally, and b another of 37 kev. which is partially converte Berthelot concludes that the metastable level is 8 kev. above the ground-level, the transition to th ground-state taking place in cascade through a intermediate level. The two radiations follow or another within a period of less than $2\cdot3 \times 10^{-8}$ se The 49 kev. radiation is, in the view of the author, magnetic octopole, and the 37 kev. line a magnet dipole, radiation.

In a very interesting paper by Prof. Dupouy, a account was given of an electron microscope usin magnetic focusing, which gives very high resolvir power. It was mentioned by the author that a ne instrument, using protons instead of electrons, is course of construction in the Collège de Franc which it is anticipated will give a substantial increa in resolving power over that at present available.

RECENT EARTHQUAKES

DURING April 1945, three strong distant eart quakes were registered by the instruments Auckland, Arapuni, Christchurch and Wellingto New Zealand. These occurred on April 15, 19 and 2 the epicentres being unknown until results are hand from other observatories in the Pacific zon Six earthquakes were actually felt in New Zeala during the month, the largest being on April 1 wi epicentre near lat. 35° S., long. 178° W. The sho on April 7 was felt at Mapua, that on April 17 Wairarapa and Wellington, and that on April 23 Masterton.

During the same month, twenty-three earthquak and tremors were registered on the instruments Toledo in Spain. The greatest was on April when an earthquake from an epicentral distance 112·5° registered a full suite of waves, and attained maximum ground amplitude of 50 μ on the nort south component at Toledo. *The Times* reported earthquake felt over a wide area in the Province Alicante on July 2, the shock being felt most strong near Onteniente, where shocks occurred about thr ars ago. There is no report of any damage, and rther details of this shock are awaited from Spain. The United States Coast and Geodetic Survey, in -operation with Science Service and the Jesuit ismological Association, has determined the epi- ntres of the earthquakes of May 19 and June 3. he former, from the readings of seismograms tained at sixteen observatories, had an epicentre ar lat. 40·2° N., long. 126·8° W., which is off rthern California. The latter occurred at 13h. ·6m. G.M.T. from an epicentre near lat. 8·3° N., ng. 82·6° W., which is in Chiriqui Province, Panama.

During April, May and June nineteen earthquakes ere registered on the seismographs at King's College bservatory, Aberdeen, Scotland. The strongest of ese was on May 19, when an earthquake regis- red at 15h. 18m. 34s. G.M.T. and attained a maxi- um ground amplitude at Aberdeen of 20 μ on the rth-south component.

At Binstead, Isle of Wight, Mr. E. W. Pollard gistered eleven earthquakes during June; his achine was undergoing repairs during June 26 d 27.

CLOSURE AND PARTIAL SEPARATION OF A METALLIC CONTACT

THE problems associated with contacts between nominally clean metallic surfaces approaching d separating normally may be divided into two oups according to whether the path between the rfaces is metallic or gaseous. A paper by Dr. Alan irweather (*J. Inst. Elec. Eng.*, 92, Pt. 1, No. 56; igust 1945) is concerned with the first of these oups. The field of interest may be further sub- vided, as it includes both the phenomena associated th nominally static contacts and those relevant to parating contacts up to the instant when the metallic th between the contacts ceases to exist.

In the first part of the paper, all the effects en- untered in the change of resistance with current d mechanical pressure are shown to be predictable the basis of the existence of contact spots. The tents of resistance changes are directly related to e mechanical pressure. A fresh technique is scribed, by means of which the existence of the ots may be demonstrated and a lower limit assigned their number. The influence of the rate of current ding is examined, and further verification of the stic character of the yielding process is furnished. e measurements described relate to one particular tact material, a platinum iridium alloy, and to surface finish. They cover much wider ranges pressures and voltages than are encountered in ctice, and permit identification of all the significant nts observable in a normal laboratory atmosphere. is range of observations is bounded only by limits which effects cease to be those relevant to a clean tallic contact. One limit, attributable to surface ns, not necessarily due to tarnishing, is encountered very small pressures and voltages: the other ears at higher voltages which, if exceeded, result mately in glowing and fusion of the contact sur- es.

he second part of the paper is concerned with unequal wear of the two members of a contact r, termed 'selective erosion' or 'unbalanced erosion'; is frequently accompanied by a gain of material by one member at the expense of the other. In severe cases one member may develop a large pip while the other produces a corresponding crater: the contacts may then lock together. Hitherto, experience has suggested that such pips and craters occur in a random manner and that neither seems to be associated with a particular contact polarity. The work described presents a new and simplified approach to the problem. It is suggested that, in general, and perhaps more especially when quenching is permissible, unbalanced erosion results from, or can be made to result from, two main causes: first, the molten metallic bridge joining the contacts when only partly separated, and secondly, the arc. The sense of arc erosion is always the same, independent of the metal, whereas that of bridge erosion depends on the sign of the Thomson coefficient of the metal near its boiling point. Thus, metals for which the senses of the bridge and arc erosion are the same can only exhibit one sense of erosion; but those for which they are opposite can exhibit both senses, or even none at all, depending on which effect predominates due to appropriate circuit conditions. This leads to the idea of alloys so designed as to possess a zero Thomson coefficient near their boiling point, which would therefore give equal bridge erosion of both contact members. Progress has been made in the development of such alloys. The remaining unbalanced arc erosion would then be reduced as far as possible by the use of an appropriate quench. Such alloys would, of course, have to satisfy all the conventional requirements for contact materials and, if possible, one more: even with a quench, the possibility of slight residual arcing cannot be neglected, so that it would be desirable, when selecting metals for the development of balanced bridge erosion alloys, to do so from those which do not readily support an arc.

FORTHCOMING EVENTS

Saturday, November 3

ASSOCIATION OF AUSTRIAN ENGINEERS, CHEMISTS AND SCIENTIFIC WORKERS IN GREAT BRITAIN (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 3 p m.—Meeting of British and Austrian scientists in support of the restoration of Science in Austria.

Monday, November 5

FARMERS' CLUB (at the Royal Empire Society, Craven Street, Strand, London, W.C.2), at 2.30 p.m.—Prof. T. Dalling: "Sterility in Cattle".

SOCIETY OF ENGINEERS (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 5 p.m.—Mr. M. Spindel and Mr. R. T. Quinn: "Improvements on Portland Cements and Concrete —Past, Present and Future".

Tuesday, November 6

BRITISH PSYCHOLOGICAL SOCIETY, INDUSTRIAL SECTION (at the War Office Cinema, Curzon Street House, Curzon Street, London, W.1), at 1.15 p.m.—Lieut.-Colonel B. Ungerson: "Motion Study Applied to Military Problems" (with Film Illustrations).

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Dr. A. Muller: "50th Anniversary of the Discovery of X-Rays", (1) "The Background of Rontgen's Discovery".

QUEKETT MICROSCOPICAL CLUB (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 6.30 p.m.—Mr. E. A. Robins: "Trawler's Rubbish".

Wednesday, November 7

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W C 2), at 1.45 p.m.—Dr. E F. Armstrong, F.R.S.: "The Influence of the Prince Consort on Science" (Inaugural Address).

INSTITUTION OF ELECTRICAL ENGINEERS, RADIO SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. R. J. Clayton, Dr. J. E. Houldin, Dr. H. R. L. Lamont and Mr. W. E. Willshaw: "Radio Measurements in the Decimetre and Centimetre Wavebands".

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 6 p m —Mr T. W. Goodwin and Prof. R. A. Morton: "The Determination of Carotene and Vitamin A in Butter and Margarine"; Mr. J. L. Bowen, Mr. N T, Gridgeman and Mr. G. F. Longman: "A Photoelectric Method of Assaying Vitamin A in Margarine".

Chemical Society (joint meeting with the Local Sections of the Royal Institute of Chemistry and the Society of Chemical Industry) (at the Newport Technical College, Newport), at 6 30 p.m. —Dr. E. H. Coulson and Mr J. L. Jones · "Research on Coal Tar".

Thursday, November 8

Linnean Society of London (at Burlington House, Piccadilly, London, W.1), at 5 p.m —Exhibit and Scientific Papers.

Royal College of Surgeons of England (at Lincoln's Inn Fields, London, W.C.2), at 5 p.m.—Mr. C. Max Page: "A Survey of Fracture Treatment" (Bradshaw Lecture).

Royal Institution (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Prof. James Gray, F.R.S : "The Anatomy and Functions of the Brain in Lower Vertebrates", (ii) "Amphibia and Reptiles".

Institution of Electrical Engineers, Installations Section (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p m —Mr. E. C. Lennox: "Street Lighting".

Society of Instrument Technology (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 6 p m.—Discussion on "Education in Instrument Technology".

Friday, November 9

Association of Applied Biologists (at the Imperial College of Science and Technology (Royal School of Mines), Prince Consort Road, London, S W.7), at 11.10 a.m. (in the Surveying Lecture Theatre), and at 2.15 p.m. (in the Metallurgical Lecture Theatre)—Discussion on "Factors Controlling Flowering" (to be opened by Prof. F. G. Gregory, F.R.S.).

Royal Astronomical Society (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Scientific Papers.

Royal Institution (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Dr. W. K. Slater: "The Contribution of Science to Agriculture in War".

Institution of Mechanical Engineers (at Storey's Gate, St. James's Park, London. S.W 1), at 5.30 p.m.—Mr. H. O. Parrack: "Elementary Principles of Plant Organization and Maintenance for Civil Engineering Contractors".

British Association of Chemists, St. Helens Section (at the Y.M.C.A. Buildings, St. Helens), at 7.30 p.m.—Mr. S. W. Norman: "Fractional Distillation, the Theory and its Applications".

Saturday, November 10

Biochemical Society (at the London School of Hygiene, Keppel Street, London, W.C.1), at 11.30 a.m.—Discussion on "The Chemical Basis of Cell Structure and Function" (to be opened by Dr. J. F. Danielli and others).

Iron and Steel Institute (joint meeting with the Scottish Branch of the Institute of British Foundrymen) (at the Royal Technical College, George Street, Glasgow), at 3 p.m.—Mr. Basil Gray · "The German Steel Foundry Industry".

THE DISCOVERY OF X-RAYS

50th Anniversary Commemoration Programme

Inaugural Meetings

Thursday, November 8

At the Royal Society, at 11.30 a.m.
At the Royal Society of Medicine, at 4.30 p m.

Joint Meeting of all Participating Societies

Friday, November 9

At the Phoenix Theatre, Charing Cross Road, London, W.C.2, at 8 30 p.m.—Sir Lawrence Bragg, F.R.S.. "The Scientific Consequences of Rontgen's Discovery of X-Rays".

Medical Meetings

Friday, November 9

At the Royal Society of Medicine, at 10 a m.

Saturday, November 10

At the Institution of Electrical Engineers, at 2 p.m.

Scientific Meetings

Friday, November 9

At the Royal Institution, at 10 a m.

Saturday, November 10

At the Royal Institution, at 10 a.m.

Historical Reviews

Saturday, November 10

At the Institution of Electrical Engineers, at 3.30 p.m.

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Lecturers in Mechanical Engineering in the Department of Engineering of the Cape Technical College, Cape Town, South Africa —The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting C.2861.XA (November 8).

Principal of the Punjab College of Engineering and Technology, Lahore—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting C.2854.A (November 10).

Engineering Assistant on the staff of the Buildings Department—The County Architect, Kent County Council, Buildings Department, Springfield, Maidstone (November 10).

Laboratory Technician in the Public Health Department—T Town Clerk, Finsbury Town Hall, Rosebery Avenue, London, E.C (November 10).

Chemist in the Soils and Plant Nutrition Section at Lo Ashton Research Station—The Secretary and Registrar, The Univ sity, Bristol (November 10).

Assistant (full-time) to teach Mechanical Engineering, Wor shop Practice, Engineering Science, Technical Drawing, a Mathematics, in the County Technical School, Newtown—T Director of Education, County Offices, Newtown, Mon. (November 1

Speech Therapist—The Director of Education, Stanley Buildin 3 Caunce Street, Blackpool (November 12).

Meteorological Officer Cadet, Department of Industry a Commerce, Dublin—The Secretary, Civil Service Commission, Upper O'Connell Street, Dublin (November 14).

Director of Industries, Bengal—The Ministry of Labour a National Service, Appointments Department, Technical and Scient Register, Room 670, York House, Kingsway, London, W.C.2, quot C.2862.A (November 15).

Assistant with qualifications in Agriculture for a survey Fertilizer Practice in the counties of Kent, Surrey and Sussex—T Secretary, South-Eastern Agricultural College, Wye, Ashford, Ke (November 15).

Science Graduate to teach Mathematics and Physics, and Graduate in Engineering or equivalent to teach Mathematics wi some Workshop Practice, mainly in the Secondary Technical Scho for Boys—The Principal, Southall Technical College, Beaconsfie Road, Southall, Middx. (November 15).

Lecturer (full-time) in the Department of Mechanic Engineering—The Principal, Borough Polytechnic, Borough Roa London, S E.1 (November 16).

Executive Engineers (4) by the Government of Bengal—T Ministry of Labour and National Service, Appointments Departme Technical and Scientific Register, Room 670, York House, Kingswa London, W.C.2, quoting E.2048.A (November 16).

Lecturer (Honours Graduate) in Chemistry—The Secreta Woolwich Polytechnic, Woolwich, London, S.E.18 (November 16).

Lecturer in Civil Engineering—The Director, Robert Gordo Technical College, Aberdeen (November 17).

Principal of the Dewsbury Municipal Technical College The Education Officer, Municipal Buildings, Halifax Road, Dewsbu (November 17).

Master (full-time) to teach Engineering Subjects, includi Applied Mechanics and Heat Engines, to Ordinary National Cert cate standard, and Engineering Science and Technical Drawi in the Junior Technical School, Newton-le-Willows Technical Sch —The Divisional Education Officer, The Gables, Crow Lane We Newton-le-Willows, Lancs (November 17).

Head of the Department of Zoology—The Registrar, Univers College, Hull (November 17).

Engineer and Manager to the Staffordshire Potteries Wat Board—The Clerk to the Board, 20 Stafford Street, Hanley, Stoke-o Trent (November 19)

Deputy Borough Electrical Engineer and Manager to t Borough of Willesden—The Town Clerk, Town Hall, Dyne Roa London, N.W.6, endorsed 'Deputy Borough Electrical Engineer a Manager' (November 19).

Psychologist to work under direction of County Psychiat primarily for County Child Guidance Service—The County Medi Officer, 4 Barnfield Crescent, Exeter (November 19).

Head of the Civil and Mechanical Engineering Department The Secretary, Woolwich Polytechnic, Woolwich, London, S.E (November 22).

Head of the Physics, including Telecommunications, Depa ment—The Secretary, Woolwich Polytechnic, Woolwich, Lond S.E 18 (November 22).

Lecturer in the Department of Physiology, University of C Town—The Ministry of Labour and National Service, Appointme Department, Technical and Scientific Register, Room 670, Y House, Kingsway, London, W C 2, quoting F.5050.X (November

Assistant Lecturer in the Department of Engineering—T Registrar, University College, Singleton Park, Swansea (November

Abstractors (male or female) for the Intelligence Section o Research Association—The Ministry of Labour and National Serv Appointments Department, Technical and Scientific Register, Ro 670, York House, Kingsway, London, W.C.2, quoting C.2856 (November 26).

City Electrical Engineer—The Town Clerk, Guildhall, Yo endorsed 'City Electrical Engineer' (November 29).

Borough Electrical Engineer—The Town Clerk, Town H Tunbridge Wells (December 31).

Assistant Electrical and Mechanical Engineer by the Gove ment of Iraq for the Basrah Port Directorate—The Ministry of Lab and National Service, Appointments Department, 1–6 Tavist Square, London, W.C.1, quoting F.A.52.

Assistant Laboratory Technician for the Physics Departm —The Warden and Secretary, London (Royal Free Hospital) Sch of Medicine for Women, 8 Hunter Street, London, W.C 1.

Assistant Lecturer in the Engineering Department of Mining and Technical College, Crumlin—The Director of Educat County Hall, Newport, Mon.

Biochemist with a good knowledge of Bacteriology to work on degradation of long-chain hydrocarbons by micro-organisms— Secretary, National Institute for Research in Dairying, Univer of Reading, Shinfield, Reading.

Head of the Engineering Department—The Principal, Techn College, Brunswick Road, Gloucester.

Lecturer (full-time) in Engineering—The Principal, Wa Technical College, Hartshill, Oakengates, Shropshire.

Lecturer-Instructor to teach mainly Motor-Vehicle Tech logy and Repairs, including Electrical Equipment and Repai The Principal, Medway Technical College, Senior Departme Gardiner Street, Gillingham, Kent

Principal of the Imperial College of Tropical Agricult Trinidad—The Secretary, Imperial College of Tropical Agricult Grand Buildings, Trafalgar Square, London, W.C.2.

PHYSIOL Dept.

NATURE

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CONTENTS

Page
tomic Energy and its Utilization 547
overty and Politics in Central Europe. By Capt. Maurice Bruce 551
eficiency Diseases in Belgium. By Major J. Marshall . 551
atural Organic Colouring Matters. By Prof. W. Baker 552
UNITED NATIONS EDUCATIONAL AND CULTURAL ORGANISATION
Introduction. By Dr. E. F. Armstrong, F.R.S. . 553
Science and the United Nations. By Dr. Julian Huxley, F.R.S. 553
World Co-operation in Science. By J. G. Crowther 556
A Permanent International Scientific Commission. By Prof. J. D. Bernal, F.R.S. 557
The Place of Science and International Scientific Co-operation in Post-War World Organization. By Dr. Joseph Needham, F.R.S. 558
ysics and Astrophysics at the Imperial College. By rof. Herbert Dingle 562
ews and Views 564
tters to the Editors :
The Raman Effect in Rocksalt.—Prof. Max Born, F.R.S., and Mary Bradburn 567
Radioactivity of Active Nitrogen.—Dr. Kai Siegbahn and Dr. Hilding Slätis 568
Temperature Effect on Ultra-sonic Velocity in Water.—Bawa Kanwal Singh 569
Near Ultra-Violet Emission Bands of Benzene.—Prof. C. K. Ingold, F.R.S. 569
Spectra of Diatomic Oxides by the Method of Exploded Wire.—B. Rosen 570
Chromatography of Two Solutes.—A. C. Offord and Dr. J. Weiss ; Dr. E. Glückauf . . . 570
Determination of β-Carotene in Dried Grass.—T. Barton Mann and W. M. Seaber 571
Preparation of Silicic Acid Jellies for Bacteriological Purposes.—Björn Ingelman and Ingvar Jullander 572
Enamel Cuticle (Nasmyth's Membrane) and Tartar Deposition in the Ferret.—Dr. J. D. King . 572
Conditioned Excitors and Human Sense Organs.—Prof. Krikor Kekcheyev 573
Demonstration of Mitosis in Animal Cells.—Dr. W. S. Bullough 574
Late Flowering of Horse-Chestnut.—Dr. Julian Huxley, F.R.S. 574
Lantern Slides of Line Drawings.—Dr. G. D. Yarnold and L. Heath 574
S. National Academy of Sciences : Elections and Medal Awards 575
cent Investigations on the Growth of Bone. By Prof. P. Lacroix 576
entific Affairs in Europe 576
search in the U.S.S.R. on the Physiology of Vision . 579

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ATOMIC ENERGY AND ITS UTILIZATION

NO one who has followed the trend of scientific opinion since the end of the War in Europe can mistake the growing emphasis which men of science in every country where the Press is free are placing on the restoration of full freedom of scientific intercourse, and the earliest and fullest possible relaxation of the secrecy imposed by the exigencies of war-time. Earliest in point of time, though not in publication, the Barlow Committee came out so far back as 1943 with strong recommendations regarding the fullest possible removal of secrecy restrictions, and the encouragement of publication and of discussion between scientific workers in different fields, within and without the Government service, above all in fundamental research. No feature of the Government's proposal for a scientific civil service is more welcome than the statement that these recommendations for relaxing secrecy are viewed sympathetically, and that scientific workers in the service of the Government will be encouraged to publish work of their own and to discuss their work with persons outside the service engaged on similar problems.

The report of Dr. Vannevar Bush, "Science : the Endless Frontier", published late in July, shows how scientific opinion in the United States of America has reached similar conclusions, and in one of its most important sections there are outlined concrete proposals for the restoration of scientific communications by international agreement. That report was published before the disclosure of the development of the atomic bomb ; but the visit of Allied men of science to the U.S.S.R. in connexion with the two hundred and fiftieth anniversary of the Academy of Sciences (see *Nature*, August 25, *et seq.*) left no room for doubt that scientific men in the U.S.S.R. are equally anxious for the resumption of contact and communications with their colleagues in other countries. Proposals which have come from Dr. J. Needham indicate that his work with the British Council's Scientific Office in Chungking has provided further evidence of a strong desire for the removal of war-time restraints and for full freedom of intercourse in science (see also p. 558).

This urge for full freedom of communication and the relaxation of the secrecy imposed by war conditions has been greatly strengthened both by the disclosure of the application of atomic energy in the atomic bomb and by the sudden termination of the War in the Far East. Whatever has been done so far to lift the veil on achievements in such fields as radar, 'Pluto', petroleum warfare and the like has in fact fostered, rather than abated, the demand for the full disclosure of the scientific work on which such developments are based. One reason for this may be seen in Sir Robert Watson-Watt's recent article on radar (*Nature*, September 15, p. 319) ; demonstration of the practicability and value of team-work in time of war stresses the importance of team-work for purposes of peace, and team-work is only possible when the exchange of knowledge is free and full.

There is a second reason why the demand for the relaxation of secrecy is growing. Revelations of achievements during the War again and again emphasize the way in which technical advance is bound up with fundamental research, and the extent to which advances in fundamental research proceed simultaneously and on parallel lines in different countries. It is clear from what has already been made known that the original researches in atomic physics from which the atomic bomb was developed were proceeding in various countries, and this knowledge was being freely published. This point is well brought out in the Smythe Report on Atomic Energy, which has now been published, and which looks to the publication, at least in part, of the papers withheld since April 1940. Sir Henry Dale was prompt to emphasize both that the preservation of civilization may depend on the fullest freedom of scientific intercourse and on the abandonment of any national claim to secrecy about scientific discoveries. That, he insisted, is a fundamental condition if international control of the atomic bomb is to be possible; and Sir Henry Dale was one of the first to emphasize that such control, as distinct from control of science or scientific research, is essential if we are to use atomic energy to full effect and avoid the disasters which must attend misuse.

That was the point of view which Mr. L. J. F. Brimble urged in letters to *The Statesman* of Calcutta (August 15 and September 7) during his recent visit to India and which it would seem, from editorial comment and from correspondence, Indian opinion is disposed to accept. Mr. Brimble challenged the practicability of the United States and Britain being able to keep secret the knowledge relating to the production and use of the atomic bomb. Legislation to control scientific research on uranium and other aspects of chemistry or physics related to the development of the atomic bomb would almost certainly be futile. The secret of any branch of research in atomic physics cannot remain the prerogative of any one nation or group of nations. Furthermore, if such control of scientific research were achieved, it would be a deadly blow to scientific progress and the advance of civilization.

Mr. Brimble distinguished clearly between the planning of science within the conception of freedom of the individual, and political control; but these two things are still frequently confused, as subsequent pronouncements in Great Britain and in the United States have shown. This confusion adds further point to Mr. Brimble's contention that our future progress depends both on a complete change of heart among nations and on thorough overhaul of our methods of education, so that every citizen acquires some appreciation of science and some insight into the impact of science on society. These are, in fact, the fundamental conditions for effective collaboration between statesmen and men of affairs, students of the humanities, spiritual leaders, men of science and others.

Further support for the view that it is impossible to maintain secrecy regarding the scientific developments leading to the atomic bomb has been forthcoming from Prof. J. D. Bernal (who, pointing o that secrecy would restrict the free flow of scienti information to the grave detriment of the recove of international science, urged that rapid progre could only come from the free exchange of inform tion) as well as from others in Great Britain a from various groups of American men of scienc The Association of Los Alamos Scientists, f example, comprising some four hundred of tho working there on the atomic bomb project, has be formed to promote the use of scientific and techn logical advances in the best interests of humanit and recognizes that scientific workers, by virtue their special knowledge, have, in certain spher special political and social responsibilities beyo their obligations as individual citizens. In co formity with this policy of releasing authoritati public statements on scientific questions in th relation to society, the Association issued a stateme on October 13 that there could be no keeping t secrets of the atomic bomb from the rest of the wor and that to attempt to do so would lead to w more savage than the last (see also p. 564).

The statement urged that the use of atomic ener must be controlled by a world authority and th such international control is technically feasib although it may involve the abolition of secrecy national and international relations and the provisi of free access to all laboratories, industries a military installations. It is the hope of the Assoc tion of Los Alamos Scientists in developing the bo that it will be a great force for world co-operation a peace. Lack of decision within even a few month the statement urges, may lead to unprecedent destruction.

These views have been substantially supported other organizations, such as the Atomic Scientists Chicago, who flatly challenged a report issued October 11 by the Naval Affairs Committee of t House of Representatives as contrary to exp scientific opinion. The Chicago group said th reports which suggest that effective counter-measu have been developed are misleading, and that sta ments attempting to minimize the importance of t atomic bomb and suggesting that armed forces w soon bring the situation under control would incalculable harm. The legislation which is be considered by this Military Affairs Committee been strongly opposed by both these groups scientific men as likely to retard research and development of atomic energy rather than stimul it. It is also feared that the proposed atomic ene control commission will prevent the exchange information between co-workers in the same labo tory, and that this, in accordance with the views the Barlow Committee in Great Britain, would d young men of science from the work, because transfer of information is vital to research in scien

The Association of Oak Ridge Scientists at Clin Laboratories, Tenn., composed of more than 90 cent of the scientific, engineering and technical st of the main research and development section of Plutonium Project, was formed late in Septem because its members felt they should take a gre ponsibility for the consequences of their handiwork. e Association was born out of fear that the wrong urse was being taken in regard to at least two ects of the atomic bomb. The first was the growing e sense of security prevalent when it was thought re was a secret formula for the atomic bomb held lusively by the United States and Great Britain. e second was apprehension that the atomic bomb s creating a feeling of fear among nations rather n of trust, and it seemed plain that unrestrained velopments in this field would only add to such r. This feeling of apprehension led to the view, d by a large portion of the membership of the ociation, that control of atomic power should be an international rather than national level, for it s felt that control of atomic power on a national el would lead inevitably to the greatest armament e ever known, and to increasing distrust among tions.

he activities of the Association so far have conted mainly of contributing to informed public nking in every way possible. Numerous statements ve been prepared by scientific workers who have en associated intimately with atomic bomb developnts, and the best of these have been endorsed by e Association and used as background material for lio and editorial comments, for Congressional arings and for personal contacts. If science is to controlled on a national level, the Association ieves that the inevitable armament competition l prevent science, especially 'nucleonics', from r being free again; and that scientific freedom as have known it will not again prevail until a lomacy of trust and good will is established among tions.

Dr. H. L. Anderson and Dr. Leo Szilard, on the er hand, have criticized the U.S. War Department publishing the Smyth Report on the development atomic energy, to which Lord Maugham referred the House of Lords on October 16. Dr. J. R. penheimer, who has just resigned his post as ector of atomic research at Los Alamos, declared ore the Senate Committee at Washington on tober 17 that the only defence against the bomb proper international organization, and Dr. H. J. rtis, representing scientific workers at the atomic oratories at Oak Ridge, Tenn., told the Comtee that the only solution to the secrecy problem o turn over to an international organization the trol of all aspects of atomic power.

nternational responsibility for the control and elopment of atomic energy was the theme of the ling article in *Nature* of August 11 immediately owing the dropping of the first atomic bomb. s, and the impracticability of secrecy, have been ssed many times since in these columns. But debate in the House of Lords on October 16 ws how, in Great Britain as well as in the United tes, political issues are liable to overlay and cone the scientific and technical aspects, particularly relation to the question of secrecy which we are v discussing. Nor was the position made clearer President Truman's early pronouncements; and d Maugham in the course of his speech did well to bring out the difference between attempting to keep secret the fundamental knowledge in atomic physics with which the development of atomic energy for any purpose starts, and the engineering technique involved in the production of the bomb itself. For the latter, indeed, it would be reasonable to argue for secrecy and the development of some effective means of control; but for the former, secrecy must be rejected as impracticable, as impolitic, and as contrary to the interests of science or humanity. It is clear from the debate in the House of Lords that there was general agreement as to the impracticability of secrecy in this respect; further, the Earl of Darnley found little support for his notion that adequate supervision of manufacture or the foreseeing or prevention of use of such weapons were equally impracticable. Rather, the opinion was that such control is difficult, but that it is absolutely imperative for appropriate means to be worked out with the utmost possible speed.

President Truman's address on American foreign policy delivered in New York on October 27 would seem to imply that he has at last arrived at similar conclusions; for he said: "We must find the answer to the problems created by the release of atomic energy—as we must find the answers to many other problems of peace—in partnership with all the peoples of the United Nations". Discussion of the atomic bomb with Great Britain and Canada will begin in the near future, and later other nations will be brought in. These discussions will look "towards a free exchange of fundamental scientific information"; but he emphasized that they will not deal with the processes of manufacturing the atomic bomb or other instruments of war. President Truman's pronouncements have met with some keen opposition even in the United States.

The issues were in fact more clearly displayed in the short debate initiated by Capt. Blackburn in the House of Commons on October 30. Capt. Blackburn strongly associated himself with scientific opinion that at the earliest possible moment we should get back to the peace-time exchange of scientific information, and in view of the impossibility of damming the river of knowledge, urged immediate internationalization of research and production in relation to atomic energy, and the calling of a conference of scientific workers as well as statesmen to recommend to the United Nations the best system of international control of atomic energy which can be devised. Sir Arthur Salter, quoting the points made by the American scientific workers already mentioned, and in particular Dr. Urey's declaration that peace-time application of atomic energy was of no importance unless the danger of atomic bombs was banished, stressed the urgency of the situation and pleaded for an immediate offer to place all information in the hands of the Security Council conditionally on an effective system of inspection. That plea for urgency cannot but be reinforced by the Government decision to set up a research and experimental establishment for atomic energy.

What has hitherto been lacking appears to be a convincing statement of the reasons why secrecy regarding the scientific aspects of the development and use of atomic energy should be dismissed forthwith from consideration as practical politics. It is generally recognized that so much is already known to many scientific workers in different countries that secrecy in this respect is a mere pretence. It has also been emphasized that restrictions in this field will only impede the scientific advance upon which the utilization of atomic energy for beneficial purposes depends. That is true, but Lord Addison went nearer to the mark when, in winding up the House of Lords debate, he expressed the opinion that it is not possible to circumscribe the activities of scientific research. The British Government has in fact consistently taken the right line in refusing to treat the atomic bomb as a special case. Mr. Bevin has insisted that it is not merely the atomic bomb but the whole advance of science in the field of war which must be controlled. Similarly, we cannot impose restrictions or secrecy in those branches of science which have contributed to the development of the atomic bomb without regard to the effect of such restrictions on scientific advance generally. We cannot predict from which field of science the next important advance may come, and to impose restrictions anywhere is to impede that interchange of thought, that cross-fertilization of minds and exchange of ideas from which all great advances have come without acquiring in return any solid assurance that investigations, of which we may know nothing, proceeding in other countries will not yield just the startling results that we dread.

Secrecy, therefore, is impracticable and contrary to the advance of science and the interests of humanity. No less important, secrecy in this field of scientific knowledge is impolitic as endangering that very confidence and good will which must be the basis of any organization for international control of the engineering technique of production for war purposes which is so vital and urgent. Nothing makes more powerfully for confidence and co-operation than the effective fellowship of scientific workers across national frontiers, the constant communication of each fresh advance as it is achieved and the interplay of minds engrossed in the search for truth over the problems and difficulties as they emerge. Nothing breeds suspicion and distrust more quickly than the withholding of new knowledge, the refusal to share it with others. It is not merely that scientific effort is wasted in duplication, or that the stimulating clash of minds is interrupted and the general advance of science is delayed. Perhaps even more important at this juncture is that, in place of co-operation and team-work, we have distrust and insecurity and a competition which can only result in disaster.

These are the reasons, therefore, why British men of science welcome the attitude of the British Government on this question of secrecy generally, and its refusal to treat the question of atomic energy as a special case. Mr. Herbert Morrison's statement on October 30 indicates no lack of appreciation on the part of the Government as to the urgency of the political and scientific issues involved, and in asserting the Government's intention to maintain a high standard of fundamental research and to plan m carefully the whole programme of research a development to make the best possible use of o resources, he gave welcome evidence of continu high interest in science and scientific workers. It clear that much remains to be done to educate publ opinion as to the critical importance of this issue, f it forms the starting point of an adequate policy ; a unless the implications which follow from this aba donment of a futile attempt at secrecy are realize we cannot expect the public in Britain or in ot countries to support their Governments in maki the sacrifices of national sovereignty that are involv in effective international control of the new weapo of war. Lord Cherwell was undoubtedly right maintaining that we could only hand over all t technique involved in such production to a bo which could be trusted to use it in the interests humanity; and the powers and organization of a such body have yet to be elaborated.

The House of Lords debate gave very little guidan as to the form or nature of any such organizati but both Lord Cherwell and Lord Addison we realistic and attempted to face the difficulties and find a genuine solution. As explicitly as the Bish of Chelmsford, Lord Cherwell recognized the need f a moral imperative, the over-riding need of findi means, at no matter what cost and sacrifice, reaching agreement without resort to force. Lo Addison quoted again the declaration of the Forei Secretary that "it is the aim of His Majesty's Gover ment that under the world organization we shou eliminate the desire to exploit the discoveries science for the purposes of war, and turn them i channels where they can serve the advancement humanity and human well-being". Holding that no apparatus for devising secrecy would humani be able to safeguard itself against this peril, he urg that our first effort must be directed towards creasing the international machinery which more a more puts a value on co-operation between natio and which more and more helps to remove the cau of distrust between nations.

That there should be so large a measure of agr ment among scientific workers as to the impract ability of secrecy in any field of science, and untoward effects on the advance of science and human welfare, is all to the good. Such recognit carries with it the responsibility of seeing that reasons for that attitude are understood by t fellow citizens. Above all, it must be demonstra that this is a positive and not a negative attitu that the abandonment of secrecy involves a fr effort to build the instruments and institutions effective control of the agencies of war in any fo and to create a moral imperative, whether in search for truth or in religious conviction, str enough to overthrow whatever forces of suspicion embedded prejudice or inertia, may stand in the w of the adoption of the means required to deal w the new situation with which these fresh advan in science have confronted mankind. Scient workers cannot be blind to the fact that there powerful forces opposing international co-operat and the exchange of scientific information, as the restrictions placed on the entry of British scientific and technical periodicals to parts of Germany and to Japan at the present time indicate. Never perhaps could they take to themselves more appropriately than at this juncture the words of Sir Francis Drake's prayer that in endeavouring such a great matter "it is not the beginning, but the continuing of the same until it is thoroughly finished, which yieldeth the true glory".

POVERTY AND POLITICS IN CENTRAL EUROPE

The Danube Basin and the German Economic Sphere
By Dr. Antonin Basch. (International Library of Sociology and Social Reconstruction.) Pp. xiv+272. London: Kegan Paul and Co., Ltd., 1944.) 18*s.* net.

Germany and Europe
Political Tendencies from Frederick the Great to Hitler. By Dr. F. Darmstaedter. Pp. vi+226. London: Methuen and Co., Ltd., 1945.) 12*s.* 6*d.* net.

DR. BASCH surveys in his book the economic problems of the Danubian States and their international repercussions—a subject of major importance for the period of reconstruction that has now begun, and one that has a vital bearing upon the future place of Germany among the nations. The book was written in 1943 and does not, therefore, take into account the important developments of recent months; but it provides a valuable study of the economy of a great region, extending from Czechoslovakia through Austria, Hungary, Yugoslavia, Rumania and Bulgaria, to Greece, and, though it concentrates on the key period of the 'thirties, it glances back to the situation before 1914 and makes some constructive suggestions for the future.

The work is authoritative, for Dr. Basch himself played an active part in many of the developments he describes. As a leading Czech economist he combined for some years a teaching post at the University of Prague with economic research for the National Bank of the Republic: later he became head of the Czech chemical industry and a member of the Economic Board of the Little Entente. He is mainly concerned with the political and economic opportunities that were missed in 1919 and subsequent years, and with the need for a better understanding of the Danube region's role in international affairs, for he is able to show only too clearly how the indifference of Britain and France to the economic problems of the region played into Germany's hands. But underlying all that he says of the economic activities of the seven countries, with their total population of nearly eighty millions, is an awareness of the human tragedy of economic backwardness which the Nazis exploited for their own ends. The consumption of food, and especially of protective foods, Dr. Basch points out, was "extremely low" throughout most of the region: only about one seventh of the agricultural area was devoted to protective foods, as against one third in western Europe. Yet foodstuffs and other agricultural produce had to be exported in order to buy essential raw materials and manufactured goods.

It was this situation, aggravated by the world slump in agricultural prices, by German agricultural protection, and by the indifference of the Western Powers (thus Britain, which before 1914 had bought Greek tobacco every year up to the value of £9,000,000, took only £20,000 worth in 1937), which gave Germany from 1934 the opportunity of using her purchasing power, through bulk buying, to turn the Danubian area into a dependent colonial, or semi-colonial, region, bound ever more closely to the Nazi military machine. German propagandists maintained that south-eastern Europe was the 'natural' sphere of German economic development and that the peoples in it would gain from their association with the Reich. In truth, German interest was rather in the military and strategic possibilities of economic control, as was made clear in 1941. Dr. Basch is able to show how heavily the bargain weighed against the Danubian peoples—and how little Germany gained, relatively, by her economic control. The conclusion is overwhelming that international, national and personal problems are indissoluble; that Europe cannot again run the risk of leaving the Danube area an agricultural slum. Peasant poverty and German hegemony are the same issues seen from different angles. The solution must lie in improved agriculture, with co-operative farming, in capital investment from abroad, in industrial development, and in the planned exploitation of natural resources. "An ultimate change in the economic and social status of this neglected region will provide a new and safer balance for Europe as a whole."

The nature of the German domination which turned peasant difficulties to its own ends is examined in Dr. Darmstaedter's book. He surveys the development of the German Power-State from the time of Frederick the Great, and sees it arising as the result of the weaknesses and divisions of German political life. Now National-Socialism has failed to give the German people the unity they have long sought, and a final solution of their problems can only be reached in a "European Commonwealth" in which Germany has an equal place. The argument is sound, if not always too clearly expressed: the conclusion would seem at the moment rather remote.

MAURICE BRUCE.

DEFICIENCY DISEASES IN BELGIUM

Les états de carence en Belgique pendant l'occupation Allemande 1940–1944
Par Lucien Brull, G. Barac, T. Brakier-Zelkowiecz, P. Clemens, R. Crismer, J. Deltombe, A. Divry, L. Dubois, L. Dumont, L. Dumont-Ruyters, A. Lambrechts, R. Neuprez, A. Nizet, M.-J. Op de Beeck, J. Piersotte et A. Thomas. (Institut de Clinique et de Policlinique médicales: Université de Liége.) Pp. 286. (Liége: Éditions Soledi; Paris: Hermann et Cie., 1945.) n.p.

THIS volume contains sixteen papers by different authors dealing with various aspects of dietetic deficiency as studied in Belgium during the years of German occupation.

Protein deficiency appears to have been the most important factor in the production of disease in war-time, and several papers are concerned with the effects of this deficiency on serum protein levels, œdema, etc.

Diseases due to vitamin deficiencies were little in evidence and the authors do not agree with the well-meaning theorists who advocated vitamin tablets where a square meal was wanted. Iron-deficiency anæmia and osteomalacia were likewise rare. The necessary vitamins, iron, etc., were obtained from whole bread and vegetables, and from milk and cheese, which were available for several months of the year.

Severe cases of Graves's disease were uncommon, and it is suggested that under-nourishment was responsible for this and outbalanced the opposite effects of increased emotional disturbance caused by the occupation.

Peptic ulcer was increased in incidence, largely due to emotional stress; but partly perhaps by the low fat-content of the diet. Other diseases of the gastro-intestinal tract were little affected in war-time except in that constipation was less frequent because of the diet comparatively high in carbohydrate and residue.

The last article would have been better omitted. On totally inadequate evidence the author cites infected scabies as the causal factor in a few cases of acute and subacute nephritis. Scabies has been so common all over occupied (and unoccupied) Europe that its presence in the cases described was almost certain to have been coincidental.

Belgium appears, on the whole, to have suffered less dietetic deprivation under the Germans than most of the other occupied countries; but, as Prof. Brull points out in his introduction, the conditions under which some of the authors had to work were iniquitous.

This interesting preliminary survey can only be recommended to those who read French, as the summaries in English which follow the articles are so condensed that they fail to convey the proper sense.

J. MARSHALL.

NATURAL ORGANIC COLOURING MATTERS

The Chemistry of Natural Colouring Matters

The Constitutions, Properties and Biological Relations of the Important Natural Pigments. By Dr. Fritz Mayer. Translated and revised by Dr. A. H. Cook. (American Chemical Society, Monograph Series No. 89.) Pp. 354. (New York: Reinhold Publishing Corporation, 1943.) 10 dollars.

THIS book will be warmly welcomed by all organic chemists who are interested in natural products. The colouring matters described are either of vegetable or animal origin, with the one exception of the organic mineral graebeite, a derivative of a polyhydroxyanthraquinone. The word 'Organic' would find an appropriate place in the main title of the book, and the subtitle would more accurately read "the Properties, Constitutions, and Syntheses of the Important Natural Pigments". There is naturally little discussion in the book on the biological relations of the colouring matters or of their mode of synthesis in Nature, as these are topics about which we possess extremely little knowledge.

The need for an up-to-date book dealing with this subject has been widely felt for many years, and it is natural to compare the present volume with A. G. Perkin and A. E. Everest's "The Natural Organic Colouring Matters", published in 1918. The advances revealed are most outstanding in our knowledge of the structures of the complex pigments of the carotenoid and porphyrin groups; in the carbocyclic and oxygen-heterocyclic series the advances are chiefly in the large number of new pigments which have been isolated since 1918.

In the foreword written by Dr. Mayer in 1939, th work is described as a completely revised text base on the second volume of the third edition of h "Chemie der organischen Farbstoffe", translated b Dr. A. H. Cook. The untimely death of Dr. May in 1940 and war-time difficulties delayed the pub lication of the volume, and the opportunity wa taken by Dr. Cook to revise the text to includ papers published up to the summer of 1941.

Chapter 1 contains a comprehensive account (8 pages) of the carotenoids, and this is one of the mos valuable sections of the book. Chapter 2 describ curcumin, the sole representative of the dicinnamoy methane class. In Chapter 3 (60 pages) are describe the carbocyclic colouring matters, which are near all derivatives of *p*-benzoquinone, naphthoquinone anthraquinone. The account of the many compoun containing a heterocyclic oxygen atom is given Chapter 4 (108 pages). Compounds containin heterocyclic nitrogen atoms are described in Chapter (71 pages); these include the pterins isolated fro butterflies' wings, a long account of the porphyrin and shorter accounts of the derivatives of indigo an pyrazine, the latter including riboflavine. Whe there are many pigments of the same type, gener descriptions are given of the properties and metho of synthesis of members of the group, followed b brief descriptions of the individual members. Th book contains more than two thousand references the original literature, and has an author and a fu subject index.

It may be doubted if it is wise to adhere too rigidl to the division of natural organic compounds in those which possess, and those which do not posses colour visible to the human eye. Such a distinctio is very artificial and has not been strictly followed the volume under review. For example, Chapt 4 includes descriptions of the colourless substanc flavone, catechin, cyanomaclurin and several othe presumably because of their similarity to relate coloured compounds; but the same liberality is n shown in the coumarin series, of which the so representative is daphnetin. Many naturally occurri coumarins are known, but they are largely of th phenol ether type and are colourless; had the happened to exist as free phenols, many wou have been coloured and would have receiv mention.

To the organic chemist this book is a well-stock herbaceous border showing every variety of colo and a few welcome colourless blooms. It would too much to expect to find no weeds among su profusion; but it is surely time that pentacovale nitrogen atoms and tetracovalent oxygen atom should be rooted out. Close inspection reveals moderate crop of accidental weeds, among whi may be mentioned a number of errors on pages 2 and 243, where the main reactions of brazilin a shown; vanillic acid (p. 229) is shown as *iso*vanil acid; hydroxyl groups are missing from formulæ pages 167, 201 and 205; flavane (p. 162) lacks phenyl group; purpurogallin (p. 103) is named its glycoside dryophantin. It is unfortunate that t most important method for the synthesis of flavon and flavonols, the fusion of an *o*-hydroxyketone wi the anhydride and the sodium salt of an aroma acid (Allan-Robinson), should have received menti only as an 'also ran'.

This is a valuable book, and it is to be hoped th it will be kept up to date by frequent furth editions.

W. BAKER.

A UNITED NATIONS EDUCATIONAL AND CULTURAL ORGANISATION

INTRODUCTION

By Dr. E. F. ARMSTRONG, F.R.S.

Adviser to Delegates of H.M. Government

THE United Nations Educational and Cultural Conference that opened in London on November 1 has been called to prepare the establishment of a United Nations Organisation for promoting educational and cultural co-operation.

It is natural that a new effort towards world co-operation in the cultural field should occur after the devastations of the Second World War. We wish to epair the damage to our friends and ourselves as quickly as possible.

This is particularly serious in the cultural field. The damage that the enemy has done to things of he mind is even more appalling than the terrible material destruction for which he is responsible. Vile deas have been instilled into the young, and the best traditions of research and learning have been debased.

The chief way by which the victims can be restored o civilization is by education and rehabilitation. It s, however, impossible to teach and to train the mind in research and rational inquiry without schools, and apparatus and laboratories.

One of the main aims of the Conference will be to create an Organisation that will help to achieve this estoration.

A second matter of equal importance is the promotion of educational, scientific and cultural co-operation in the future. Men of science will expect hat due weight should be given to science in the onceptions and machinery of the new Organisation.

The place of science in the structure and outlook of modern civilization has been growing steadily for enerations. Almost every aspect of production, ansport, nutrition, health and the primary needs of fe are dependent on it. The influence on modes of hought in research and learning, and spiritual ttitudes, is equally great. The application of the cientific mode of thought to the problems of man nd society is perhaps our chief hope for the future. ut we cannot utilize it if we do not know what it . We want to see the restoration and improvement f education, with appropriate weight given to cience, in view of its contemporary importance.

The latest developments of atomic energy make he need for the understanding and use of science ot a thousandfold greater.

Thus it is profoundly necessary that science should have due place both in the conceptions and aims of he new Organisation, and in its machinery.

The most perfect plan and organization will not work, however, without finance and public support, and these must be based on public approval.

Another point of equal importance is the question f priorities. It is essential that the Organisation ould be able to secure the needed equipment, after has acquired the adequate finance. Teaching and research cannot be done without apparatus, scientific erature, and communications.

Men of science throughout the world hope that the onference will have every success, and that, as a sult of the discussions, a new Organisation will be established which will strengthen existing scientific collaboration and create new links where they are needed.

SCIENCE AND THE UNITED NATIONS

By Dr. JULIAN HUXLEY, F.R.S.

THE proposals for the new United Nations Educational and Cultural Organisation were first put forward by the Conference of Allied Ministers of Education, which has sat in London since 1941, and in some of its later work was assisted by a delegation from the United Nations. This body was originally concerned with the immediate and essentially short-term task of securing the educational and cultural reconstruction of those parts of Europe and Asia which had suffered cultural distortion or destruction at the hands of the Axis Powers; and in April 1944 it formulated proposals designed to meet these needs. At San Francisco, however, this aim was extended and generalized, and it was proposed that a permanent special agency of the United Nations, devoted to educational and cultural tasks, should be established. The present Conference is engaged on the problems of giving final form to the draft charter of the Organisation put forward by the Allied Education Ministers, and broadly outlining its main aims and functions and of delimiting its field of action; after which it will set up an interim commission to work out details and to prepare the ground for the first full Conference to be held about a year hence.

Another historical point is also relevant. Since the original sponsoring body was a Conference of Education Ministers, the present Conference is one of delegations appointed by the Ministries of Education of the United Nations, convened by the British Ministry of Education, and presided over by the British Education Minister. Further, the emphasis in the original proposals was largely upon education. Some stress was later laid on culture, and the word 'Cultural' was included in the proposed title; but in spite of the fact that the Allied Education Ministers had a sub-committee to deal with scientific questions, science received less consideration, and proposals to include the word 'Scientific' in the title were at first rejected.

The Ministry of Education has now invited comments from a large number of bodies concerned with the educational, cultural and scientific life of Britain, and undoubtedly the replies of the scientific bodies will have ensured that the fullest consideration will be given by the British Delegation, and may we assume by the Conference as a whole, to the claims of science. However, there is no harm in rehearsing here some of the considerations which occur to most men of science who have given thought to this important subject.

In the first place, they consider it essential that the word 'Science' or 'Scientific' should occur in the title of the Organisation—that, in transatlantic phrase, the Conference should put the S in UNESCO. Opposition to this appears to come from two quarters

—from certain educational circles who fear that the educational side of the new Organisation might come to be overshadowed by the scientific side; and from certain scientific quarters who dislike the idea that science is not 'cultural'. However, although of course 'culture' is a term of such loose definition that it may be stretched to include the totality of man's social activities, it *is* customarily used to include the humanities, literature and the arts, and in contradistinction to science. Further, even if culture in a partially restricted sense can be taken to include pure science, it is difficult for most people to envisage applied science and technology as falling within its sphere. Finally, if culture be enlarged to include science, it should, by the same token, include education as well. Thus, on every ground it would appear right to call the new Organisation either simply 'Cultural', or else 'Educational, Scientific and Cultural'.

However, the question of organization is more important than that of nomenclature. Here, too, most men of science are agreed that it is essential that a separate and relatively autonomous division devoted to the sciences and their application should be set up within the Organisation. There would presumably be other equivalent divisions dealing with education and with culture in the sense previously mentioned; in addition, a further division has been suggested in some quarters to deal with the "General Dissemination of Ideas", that is, the international aspects of the press, radio, cinema and the like, and laws concerning freedom of conscience, speech and assembly.

Each division should then have its own assistant director-general, its own secretariat, its own share of the general budget, and its own representation on the Council or other executive body of the entire Organisation. Such a council, with the director-general of the United Nations Educational and Cultural Organisation as its chairman, and again its own share of the secretariat, would consider questions of general policy and the co-ordination of work between the separate divisions; but most of the actual work of the United Nations Educational and Cultural Organisation would be carried out by the separate divisions.

A subsidiary question remains. Should there be two scientific divisions, dealing with the natural and social sciences respectively; or only one, dealing with both? There is a good deal to be said on both sides. But there is one consideration which is perhaps of an over-riding nature. The time appears to be ripe for extending scientific methods into many fields of social and economic life, both in respect to their study and to their practical direction and control, and for associating workers in the natural sciences with social and economic policy (witness the success of the application of scientific method in so-called 'operational research', in the social activity we call 'war'). If this be accepted, then it would seem important to make the attempt to unite the social and natural sciences and their applications within a single division: if this should prove impracticable, it would be easier to split a single division into two than to combine two separate divisions, each with its own outlook and traditions, its own *amour propre*, its own staff, into one.

There will clearly need to be considerable liaison between the separate divisions of the United Nations Educational and Cultural Organisation (a liaison which will presumably need to be co-ordinated from above by the executive board, and to be effected horizontally between the divisions). Thu the scientific division will be deeply concerned abou the place allotted to science at all levels of education and about the methods of scientific teaching, as wel as with the popularization of science by press, radio etc.; and in so far as the cultural division deals wit philosophy and history, it will be concerned abou the application of methodology of science to thes and similar subjects.

In another article Mr. Crowther deals with some o the specific projects which the scientific divisio might undertake. Here let me merely sketch its mai possible functions. In the first place, it should assist stimulate, and co-ordinate the activities of existin international bodies in science—such as the international scientific unions, the international work i locust control, etc. Secondly, where some field i inadequately covered, or not at all, by existing international agencies, it should either promote such a agency or itself initiate and carry out the necessary survey and research. Thirdly, it should assist an promote the speediest possible diffusion of nev scientific knowledge and ideas—by exchange of books periodicals and reports; by promoting rapid publication; by improved facilities for translation, abstracting, and providing reviews; by promoting specia meetings of scientific workers to discuss pure scientifi problems (notably perhaps in rapidly growin 'borderline' fields) and urgent practical application of science; and in other ways. Fourthly, it shoul assist and promote the exchange of scientific personnel at every level—students, especially researc students; teachers, both in schools and universities mature research workers; etc. Fifthly, it shoul promote world science by assisting the growth o science in countries in which it is quantitatively o qualitatively under-developed—by helping in th provision of books and periodicals and apparatus, b travelling scholarships, research studentships an professorships in both directions, and above all b helping scientific workers in these countries to hav speedy access to new scientific methods and result in the rest of the world. The success of the Britis Scientific Mission to China shows what can be don in this field by bilateral action: this would be mult plied many-fold by proper international organization

So much for a United Nations Educational an Cultural Organisation. But it must be emphasize that, however satisfactory the place of science in thi Organisation, there will remain other importan functions for science to perform in the internationa sphere.

Let us recall the general organization proposed f the United Nations. In addition to the Gener Assembly, corresponding to the Assembly of t League of Nations, there are three Councils directin policy at the highest level. The Security Council wi operate in the political and military field, with speci reference to the preservation of peace. The Trusteeship Council will deal with what were called Mandat Territories under the League, and other similar pro lems. And the Economic and Social Advisory Counci as its name implies, will be concerned with all oth fields in which it is hoped to secure international c operation.

In this section of international affairs, a numb of "Specialized Agencies", to quote the Unit Nations Charter, have been or will be set up deal with particular fields. The United Natio Educational and Cultural Organisation is one these; there are also in existence the Internation

Bank and the International Monetary Fund, dealing with long-term and short-term problems respectively in the financial field, and the United Nations Food and Agriculture Organisation; it is proposed to set up a United Nations Health Organisation in the near future; and the International Labour Office has just decided to divest itself formally of its original connexion with the League and to seek to enter into relation with the United Nations Organisation. It is proposed that all the United Nations agencies of this type should be "brought into relationship" with the Social and Economic Advisory Council; and many people hope that it may be possible to do the same with the International Labour Office.

The precise relationship between the special agencies and the Economic and Social Advisory Council remains to be determined. While there is no suggestion that they shall be mere organs of the Council, it seems clear that they must be subordinate in the sense that they will be on a lower hierarchical level of the General United Nations Organisation; further (with the exception of the International Bank and Monetary Fund, which will be self-supporting) they might perhaps with advantage be directly financed by it through a block grant from the general funds of the United Nations*.

With this proposed set-up in mind, it becomes clear that the United Nations Educational and Cultural Organisation, however important and adequate a role is assigned in it to science, cannot cover all the scientific functions which the United Nations Organisation should exert. In the first place, since a United Nations Educational and Cultural Organisation will be in relationship with the Economic and Social Advisory Council, it cannot be expected to play any, or any considerable, part in relation to the Security and Trusteeship Councils. Secondly, since other special organizations operating in relationship with the Economic and Social Advisory Council have scientific aspects, notably the Food and Agriculture Organisation and the Health Organisation, some machinery is required for co-ordinating scientific policy and for allotting scientific functions as between the different special organizations; and this can only be done at the level of the Economic and Social Advisory Council. And thirdly, the Economic and Social Advisory Council, the Security Council, and the Trusteeship Council will themselves undoubtedly require scientific advice on policy.

Thus while scientific work of an *extensive* type, involving either the co-ordination and assistance or the actual promotion of many detailed and concrete schemes, will fall to the share of the United Nations Educational and Cultural Organisation, and special applications of science to that of the Food and Health and the Agricultural Organisations (and perhaps of the International Labour Office also), *intensive* scientific work, involving advice on and guidance of policy, will be required at the higher or Council level.

This, it may be suggested, would best be achieved by the formation of special scientific committees of the three Councils, which would combine advisory with policy-making functions. In order to obtain the services of the highest-ranking men of science, these Committees should not be drawn from the permanent staff of the United Nations, but should meet at intervals of a few months, presumably in relation to the regular meetings of the Economic and Social Advisory Council and the Trusteeship Council; and for the Security Council, which will be in permanent session, at such times as are proved convenient. An amount of preparatory work on scientific subjects might also be required, which could of course be carried out by a few members of the permanent secretariats of the Councils.

As regards the composition of the scientific committees, the case of the Security Council is the simpler, since the scientific problems with which it is or ought to be concerned are less varied. One may suggest that a committee of 10–15 members would suffice. Owing to the technical and often secret nature of the scientific problems involved, the members would presumably have to be drawn from the permanent scientific advisers of the Armed Services of the eleven nations composing the Council, or from independent men of science who had been closely associated with scientific advisory work for their Service Departments.

It may further be suggested, in view of the overwhelming importance of science in various questions with which the Security Council will inevitably be concerned (such as the control of atomic weapons and the regulation or inspection of pure scientific work in atomic physics), that a proportion of the members of its scientific committee who by virtue of their training are able to understand both the immediate and the long-range implications of scientific ideas and applications, should actually sit at the meetings of the Council itself, as observers taking part in its discussions.

In the case of the Economic and Social Advisory Council, the scientific committee will in the first place require to be more numerous, in view of the numbers of fields of science to be covered—say 15–25 members; normally much of its work might perhaps be best carried out by sub-committees. Secondly, it will not be so imperative that its members should be drawn from among the permanent scientific staff of member nations; a considerable proportion at least could more profitably be selected from independent men of science in universities or research institutes. Among the separate subjects on which their advice would be sought would be the place of science in education, the encouragement of scientific research in general, the application of science to health, agriculture, housing, generation of power, population policy, etc.; but their most important function would be to make the Economic and Social Advisory Council aware of the broader implications of scientific advance for social and economic welfare.

The scientific committee of the Trusteeship Council will presumably have to cover fields such as anthropology, tropical agriculture and medicine, soil erosion, etc., and might include 12–20 members.

The assumption of such important roles by science in the international sphere has certain implications for its future role in national affairs. In Britain, the most obvious need would seem to be the strengthening of the Scientific Advisory Committee to the Cabinet, and the provision of a national scientific secretariat in the Cabinet Office. In addition, the internal apparatus of scientific research councils needs to be reviewed, to see whether there are not any gaps to be filled in it; some men of science, for example, consider that the existing Research Councils (including, of course, the Department for Scientific and Industrial Research) might profitably be supplemented by the creation of a Biological Research Council, which, in addition to covering a wide field of research which is not at present adequately covered by the existing Councils, could take over under unified control some of the biological projects now dispersed among the others.

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* The converse procedure, by which the special organizations would independently financed, by separate grants from separate member nations, was adopted for the special organizations of the League, namely, the Institute of Intellectual Co-operation and the International Labour Office. It is not, however, in principle satisfactory, as it does not guarantee that all member nations will take part in the work the special organizations, there is less guarantee of nations being arrears with special contributions than with a general contribution the United Nations, and it may lead to nations attempting to attach conditions to their contributions.

To return to the international sphere, it is of great importance that men of science should realize the need for 'high-level' representation of science in the United Nations Organisation, in direct relation to the three Councils. This is all the more urgent since not only is such a function of science in no way covered by the United Nations Educational and Cultural Organisation, still less by the other special agencies, but it has not yet been envisaged by the Preparatory Commission of the United Nations Organisation (see the recently published Report of its Executive Committee)—in spite of the fact that the first session of the General Assembly of the United Nations is to meet in London in January.

WORLD CO-OPERATION IN SCIENCE

By J. G. CROWTHER

THE present Conference and proposals for educational, scientific and cultural co-operation have arisen, in the first instance, through the devastation of war. When countries were invaded, millions of men and women retreated before the enemy, and hundreds of thousands came to the United Kingdom. The children and the young needed succour and education, and through this, the Ministers of Education of the occupied countries met to organize assistance. From immediate help for refugees, they passed to plans for assisting the cultural life of their countries after liberation, and then to the promotion of cultural co-operation on a new world scale. There were the three stages of relief, rehabilitation, and the advancement of civilization.

Each of these stages has its special problems. In the educational field, books and elementary teaching equipment are the most important mass need. The urgency of the provision of text-books, pencils, desks, paper, and the other elementary things is extreme. In principle, it does not seem to be a very difficult problem. The great difficulties that arise in practice are shortage of raw materials, labour, machinery and the organization of production. Their solution would be straightforward, if economic conditions were easy.

In the field of rehabilitation concerned with more advanced institutions, the problems are much less clear. How should a restored physics research laboratory be equipped? Should its old equipment be looked for, and put back; or should modern up-to-date equipment be installed? Should the balance of selection of new equipment be the same as the old?

It is evident that rehabilitation of advanced and university laboratories is a complex and highly technical job. A pooling of world information on equipment and a pooling of world opinion on methods c equipping scientific institutions are required.

The Conference of Allied Ministers of Education which gave rise to the present Conference, has alread done a considerable amount of work on the compila tion of inventories of equipment for a wide range c teaching and academic laboratories. The variou inventories for chemical, physical, agricultura medical and engineering laboratories have been compiled by committees of men of science of variou nationalities.

It is possible that their labours contain the gern of the rationalization of scientific equipment. Th new organization should extend this work.

A second needed activity is the survey of the worl needs of scientific equipment. In the process of it work, the Science Commission of the Conference o Allied Ministers of Education had occasion to estimat the value of scientific equipment that existed in nin occupied European countries. They found that it wa of the order of £100,000,000. There is a striking lac of economic data of this kind. No one ever seems t have asked before exactly what the world needs o scientific equipment might be. It is evident tha such data are essential for the planning of the mass production of scientific equipment at low prices. Fo example, steam-engines of various kinds are neede for engineering laboratories. Their price varie greatly according to whether they are needed in lot of five or five hundred. The cost of scientific rehabilitation could be greatly reduced if the worl manufacture of scientific equipment could be to som extent rationalized.

The world Organisation could promote simila action with regard to scientific and engineering text books. For example, a uniform system of units migh be introduced. A common denominator for th decimal and the foot-pound systems would enabl men of science and engineers to refer to books i any language, without the confusion of incommensurable sizes and units.

Another direction in which there is need fo positive innovation is in the types of research fellowship. Something in the nature of 'research visitor should be invented. There is a great need for th provision of small sums to enable research worke to make short visits for periods of a week to thre months, to demonstrate or learn a new technique, c to travel to a laboratory where there is uniqu apparatus, in order to make a special experimen There is very much less resource for this kind c journey than for studentships and fellowships of on year's minimum duration. The promotion of conta between men of science should be much more flexib and varied. The new Organisation should compare wh various countries are doing in this way, make a li of world resources for means for travel, and direct th attention of particularly good systems that exist one country to the notice of others.

There is general agreement that the small scientifi conference of specialists should be encourage Allied to this development is the provision of accom modation for scientific workers and men of learnin travelling about the world. A chain of houses i the leading cities and centres of the world should b developed, so that a man of science going from o country to another can be sure of a comfortabl informed and inexpensive reception everywhere. pooling of the ideas of the nations on this topic mig lead to interesting innovations.

Yet another direction for development is in th encouragement of new contacts between different branches of science. An efficient world Organisation would have unequalled opportunities for bringing together fertile new personalities and ideas, lying outside the old classifications and organizations. The most obvious ground for development is in the region between the natural and the social sciences.

While new subjects should be stimulated and fertilized, similar attention should be paid to new places. Modern means of transport and communication have brought cities hitherto quite isolated from the cultural current of the world within a few hours' journey of the main centres. A few years ago, the acceptance of a scientific post in an institute in a distant country usually meant cultural exile. With a world Organisation to assist in communications, such an outpost may offer more interesting opportunities to the research worker than he may find in the more crowded and conventional places at home.

A world Organisation for educational, scientific and cultural co-operation, conducted with a positive constructive spirit, can perform great and necessary services in the extension of existing international scientific co-operation, and the creation of new activities to meet the needs of the times.

A PERMANENT INTERNATIONAL SCIENTIFIC COMMISSION

By Prof. J. D. BERNAL, F.R.S.

Birkbeck College

It is sincerely to be hoped that the United Nations Conference for the Establishment of an Educational and Cultural Organisation will, as one result of its deliberations, set up some form of international scientific commission. Such a body has long been needed and never more than in the present period of rehabilitation and reconstruction. The experiences of the War have shown, not only in industrial countries but also in the agricultural and other undeveloped regions, that the rational application of scientific knowledge and the initiation and carrying out of research and development in relation to current problems is an absolute necessity for progress. The War has also shown that the gap which has long existed between scientific research and practical results can, with suitable organization, be drastically narrowed. This experience bears with it the responsibility for seeing that methods at least as efficient shall be put into operation with the minimum of delay for the purposes of peace.

One of the main lessons of war science was its transcendence of national boundaries. In most fields of science there was a complete pooling of British Commonwealth and United States of America scientific resources. In some fields of science, notably medical, the pooling also included, within limits of difficulties of communication, the Soviet Union and China. But the actual geographical extent of scientific collaboration was still wider; it ranged over the whole of the fields of operation of allied armies and supply services, that is, over practically all but enemy-occupied territory. The work was planned and co-ordinated in regard to problems and needs rather than to individual and national contributions. The British Commonwealth Scientific Office in Washington was a focus of common scientific planning and information such as has never existed in the world before and one well justified by its results. There could be correlated, for example, work on insecticides such as D.D.T. being applied all the way from New Guinea to West Africa, and this was not the only centre. Men of science attached to the Middle East Supply Centre at Cairo were examining all the related problems of the region—of agriculture, industry and health—from Morocco to Baluchistan. The advantages to be got from scientific collaboration on a regional basis are now proved; but to safeguard them requires a permanent form of organization which only the United Nations can provide.

Another lesson of equal importance was that the distinction between the different sciences tended to disappear in practice in this type of organization. In fact one of the main lessons of the War was that mixed research teams, ranging from mathematicians and physicists to economists and psychologists, were needed to cope with regional problems in their entirety. Even in highly industrialized countries we are beginning to find out that the physical scientists and the technicians cannot get to work effectively unless they can see their problems in a framework which only social scientists can grasp and which only statisticians can convert into figures on which quantitative action can be taken. This was effectively what was done in the building up of "operational research" during the War, and already the techniques of operational research are being applied to the building and export industries in Britain. The need for them on an international scale will be far greater.

The world of science after the War is ripe for great changes. In the United States and Great Britain science has been relatively undamaged and much increased in scope and effective organization. In the Soviet Union, in spite of the almost total devastation of the western areas, science has not only been maintained but has grown. By contrast, in the majority of the occupied countries, science has barely survived destruction and persecution, while both there and in the countries of Asia and Africa there is an increasingly conscious demand for more science. The devastated countries need immediate help, but it will not be sufficient, or, indeed, desirable, simply to return to pre-war conditions. The smaller countries already feel the need for larger units of scientific intercommunication. In a sense, German science provided this before the War, and the filling of the vacuum left by the perversion and destruction of German science is a task which can only be carried out by organized international action. It should be possible to get away from the conception which had grown up before the War, of scientific circles confined to a large extent by the circulation of journals in the same language, towards one of a world scientific commonwealth. This implies, however, a serious effort to recast the whole system of scientific publication and personal communication.

Such a task is eminently one for the new United Nations Organisation. What is a reconstitution of science in some of the European countries is, for many of the backward countries of the world, a first creation of science. The history of the Soviet Republics of Central Asia shows how rapidly science can be built up and how eagerly it is seized on by a population starting from a medieval standard of culture. During the war years we have seen another example in the extraordinary effort to expand and apply science which has been carried out under the most adverse conditions in China. The part that Dr. Joseph Needham's Sino-British Mission has taken in this effort is an extremely good example of both the needs and opportunities for international collaboration. As a result of this experience, Dr. Needham is convinced that similar international collaboration would be just as much needed and appreciated in all relatively undeveloped countries.

The men of science of this and most other industrial countries have been occupied in the last six years largely with the important tasks of war, and have engaged in international collaboration for that purpose. In this they have learned both of the unity of the natural and social sciences and that of all peoples of the world. The problems of peace can start from this experience, but there is no question of applying it in a mechanical way. Much research and discussion must take place before a complete and effective system of united world scientific collaboration can be built up. This is now of particular importance in the light of the Soviet Government's expressed view that the full organization of cultural and scientific activities should await the setting up of the United Nations Economic and Social Council. It is to be hoped that in a few months time this will have occurred and that both the natural and social sciences will find their place in an all-inclusive international organization.

THE PLACE OF SCIENCE AND INTERNATIONAL SCIENTIFIC CO-OPERATION IN POST-WAR WORLD ORGANIZATION

By Dr. JOSEPH NEEDHAM, F.R.S.

MY experience during the past two years in China in organizing and directing scientific and technical co-operation between China and the United Kingdom has led me to devote much thought to post-war international scientific co-operation. The present memorandum, sketched out in Chicago and Washington in March 1945 and completed in Chungking in May 1945, does not necessarily represent the views of any organization, but are my own views.

In the past, in times of peace, men of science themselves organized periodical international congresses for each science ; and for certain branches of science (though not for all) there were successful international unions, or permanent bureaux, able to deal with day-to-day co-operation. These unions were federalized in an International Council of Scientific Unions, which, however, was not as successful as it might have been, due to the lack of an adequate secretariat. The International Council was associated with the League's International Institute of Intellectual Co-operation, but this itself was imperfect.

In war-time all these international agencies have gone into a state of suspended animation. Under the exigencies of war, the United Nations set up in each others' capitals science co-operation offices to deal with the emergency exchange of scientific and technical information bearing on military affairs. Most of these offices, such as the British Commonwealth Scientific Office in Washington ; the United States Scientific Mission in London (under the Office of Scientific Research and Development) ; the French Scientific Missions in London and Montreal, in general much more efficiently run than anything known to international science in peace-time, deal to the extent of some 85 per cent with war science But in one case (the British Scientific Office in Chungking) a condition more similar to what might pertai in peace-time is found. These science co-operatio offices differ from pre-war international scientifi co-operation mainly in that they have adequat funds, secretariat and mechanical aids ; and are no confined to any one science, but have to promot general scientific co-operation between the countrie which they link. They are, therefore, rather a nev departure ; and point the way for the future.

The pre-war international scientific unions wer thus limited as to subject-matter ; the bilateral scienc co-operation offices are limited as to national scope What we need to-day is fundamentally an attemp to combine the methods which science has spontaneously worked out for itself in terms of peace with those which the nations have had to work ou under the stress of war. None of the machinery ough to be scrapped. The problem is to weld it into satisfactory functioning system.

In the future, there are two other types of international scientific intercourse which may grow up One is the further extension into the scientific fiel of the bilateral cultural goodwill organizations (suc as the British Council, Cultural Division of the Stat Department, etc.). The other is the appointment o scientific attachés in the principal embassies, measure which the continuing interchange of information on war science will almost certainly necessitate While there is much to be said for both these methods I feel that these methods are not fitted to play th major part, though they may well play a valuabl minor part, in the international exchange of s basically international an activity as science. Nov is the time to attempt the establishment of an International Science Co-operation Service in which supra-national loyalty would be possible, as it was i the case of the most successful League agencies.

In general, it may be said that there is a universa desire among men of science to see better internationa scientific contacts after the War. The dependence o all modern world civilization on applied science mus find its expression in the sphere of internationa relations. This desire is more strongly expressed however, the further one goes away from the grea scientific and industrial centres of Europe and th United States. The picture of world science look very different when seen from Rumania, Peru, Java Siam or China.

It is often thought that in science everyone know everyone else, and can, therefore, easily get in touc when any problem arises which calls for it. But th is not the case in the greater part of the world. Venezuelan economic entomologist may have problem very similar to that of a Chinese economi entomologist ; but the difficulties of their comin into touch are enormous. A Rumanian organ chemist may need a few grams of a substance onl being produced in India or Canada ; but if he onl knows his own language it will not be so easy to g it. The Australian workers on alunite needed f years the publications of the Chinese Nation Academy on the same subject; but were never ab to get them until an exchange was arranged throug the British Scientific Office in Chungking.

Allied to what may be called this 'peripher principle' of concentrating the help of an Inte national Science Co-operation Service where it most needed, that is, to the scientific men isolat around the periphery of the 'bright zone', is t omplementary principle of not interfering too much within the 'bright zone'. It would obviously be absurd for any international funds to be spent in communicating between people in the United Kingdom and the United States, for example, who are quite well able to communicate with each other. The International Science Co-operation Service should be directed, and indeed limited, to doing those things in international scientific co-operation which are not being done, and cannot be done, by any other channels.

The problem before an International Science Co-operation Service (or, what we are now coming to, a scientific section of a United Nations Educational and Cultural Organisation) is to steer clear of two extremes. The spontaneously arising scientific organizations before the War too often made the mistake of thinking that the battle was won when the organization was once written down on paper, and eminent men of science in different countries had accepted high positions in it. On the other hand, if care is not taken to select the right personnel, the other extreme of undue bureaucratism will kill the organization. The former danger may be avoided if adequate office management is assured, and the latter will not arise if men of science themselves fully participate.

The United Nations Educational and Cultural Organisation

While these discussions about an International Science Co-operation Service had been proceeding in the scientific world, planning had been going on for the establishment of a United Nations Educational and Cultural Organisation. Draft proposals for such an organization have been published by H.M. Stationery Office for the Conference of Allied Ministers of Education, and are being discussed by the United Nations Educational and Cultural Conference at present being held in London.

In my opinion it is desirable that the word 'science' appears in the actual title of the Organisation. This is essential, since the co-operation of men of science throughout the world is necessary. Many of them are not much concerned with teaching, since they may be in governmental or industrial laboratories; and the word 'culture' does not have in all countries the wide connotation that it has in the United States. Men of science in many countries would be likely to feel that an organization entitled only 'educational and cultural' had little to do with them. Hence I suggest that the full title of the Organisation should be United Nations Educational, Scientific and Cultural Organisation. The word 'cultural' could be assumed to take sufficient care of the humanities and the arts.

I am deeply convinced of the importance of the Organisation's name. I feel that from the psychological point of view, the avoidance of prejudice, etc., names matter enormously. The League's International Institute of Intellectual Co-operation was hindered by the lack of a good 'selling' name, and also lack of any arts of modern publicity to put it across to the intellectual world.

'Applied science' as well as 'pure science' should be written in the Organisation's constitution. If this is not done there might conceivably be a tendency later on to confine the work of the United Nations Educational and Cultural Organisation to matters of pure science without any technological aspect or bearings on the life and needs of the peoples. But pure and applied science can never be separated.

The scientific division of the Organisation should be to:

(1) Promote international scientific co-operation in all its aspects.

This general aim covers all the rest. The United Nations Educational and Cultural Organisation would not be restricted to any one group of sciences. It should also be thought of in connexion with the 'periphery principle' already mentioned.

(2) Organize and assist the better exchange of scientific information and research services between men of science and their organizations in the different countries.

While in the future there may be many opportunities for the exchange of confidential technical information between various countries, there is an enormous field of work to be done in seeing that the information actually published by government scientific organizations reaches those who need it both near and far. Moreover, the availability of scientific journals, especially the more specialized ones, throughout the world, is very restricted, and there is great need for an agency which could help isolated scientific workers with microfilmed or double-contact-printed excerpts from the literature.

Then the system of exchanging reprints, universally used among men of science and most valuable in itself, is very incomplete and unsatisfactory. It needs to be supplemented by other means, especially microfilms, double-contact prints, photostats, etc. If there were, under International Science Co-operation Service, some central stockpile where reprints could accumulate, the work of scientific workers throughout the world would be considerably assisted and much time saved.

In the field of research services, great help could be rendered by arranging for the wider use of special apparatus only available at certain places. It will be a long time before every centre has an electron microscope, a cyclotron, equipment for cutting thin rock-sections, or an ultracentrifuge. In all such work, very often the International Science Co-operation Service of the United Nations Educational and Cultural Organisation would only need to put men of science in different countries in touch with each other.

(3) Work out a plan for the restoration of scientific facilities in the liberated countries.

(4) Work out a plan for the provision of German and Japanese reparations in the form of scientific apparatus and research chemicals.

(5) Work out a plan for the utilization of such surplus war material and equipment as would be suitable for use in scientific research, and its transfer to the more scientifically backward countries.

(6) Assist in maintaining contact between government organizations concerned with science, pure and applied, when necessary; and advise governmental and diplomatic personnel on scientific matters, when desired.

It is probable that government organizations concerned with science in the major countries can communicate with each other quite satisfactorily without the good offices of any new international organization. But is this equally the case between the forestry service of a Balkan country, let us say, and the economic entomology bureau of one of the smaller States in South America? The diplomatic representation of the smaller Powers abroad can never be expected to be elaborate enough to handle all such technical inquiries. There is thus a large scope for an International Science Co-operation Service which would know no limitations of language or geography.

Again, if scientific attachés are appointed in the embassies of the larger Powers, competent advisers will be available to the diplomatic staffs. That this is most desirable would be readily admitted by all of them. But the smaller Powers can scarcely be expected to appoint such advisers, owing to lack of sufficient personnel. There is much, therefore, for the International Science Co-operation Service to do in this direction, and its supra-national character would render it all the better qualified to do it.

(7) Assist the free flow of essential research apparatus, chemicals and equipment across national boundaries.

A helping hand might be very useful, especially in the matter of customs duties and procedures. The International Science Co-operation Service could press, for example, for increased facilities for movements of apparatus, at least in the medical sciences. It would also do everything possible to encourage the production of scientific apparatus by local initiative from materials locally available. The Committee on Scientific Equipment of the Conference of Allied Ministers of Education has already emphasized these points.

(8) Assist the free flow of scientific books, periodicals, microfilms, manuscripts for publication, translations, abstracts, etc., across national boundaries, and especially between world regions of widely different linguistic pattern, for example, those of the ideographic and alphabetic languages.

(9) Assist the free flow of men of science coming and going across national boundaries, whether for periods of study or research, or for congresses, conferences and the like.

Here the International Science Co-operation Service would have to work in close contact with the continuation committees of the great international congresses, for example, those of physics, zoology and geology, usually triennial, and the smaller special conferences which have grown up in special subjects, for example, the Annual Conference on Differentiation and Growth. The more complete the return to normal after the War in matters of travel, passports, and the like, the less need there will be for an International Science Co-operation Service of the United Nations Educational and Cultural Organisation to exert any special influence in the direction of assisting the movements of men of science. But even if this return successfully takes place, there will be room for a long time to come for financial and other assistance to competent men of science to travel.

Allied to this is the helping hand which International Science Co-operation Service could give in the preparation of all kinds of scientific expeditions in zoology, astronomy, etc.

Then again, there are particularly interesting parts of the world which are unable themselves to finance the investigation of their natural products. The International Science Co-operation Service could help, either by financing the necessary investigations or by bringing the need to the notice of the existing world financing foundations.

An interesting proposal has been made by Dr. F. W. Went of the organization of temporary research groups in specific topics. Some of the more important investigators of a certain controversial subject would be brought together for a period of some months in one laboratory, during which time each would demonstrate the experiments on which he bases his own conclusions, and also work with the method and materials of some of his opponents. As examples twelve investigators hold fourteen different theorie of bud inhibition, each man concentrating on a different aspect and using a different experimental plant; and there are no less than ten mutually contradictory theories of translocation of carbohydrates in plants. The expenses of such research gatherings, and the arrangements for them, could properly be undertaken by United Nations Educational and Cultural Organisation.

(10) Promote plans of international collaboration in research.

This, of course, overlaps with the last heading. I would require close contact with the internationa scientific unions, which in the case of such sciences as astronomy, geophysics, geodesy and radio physics have been in the past, and no doubt will again be in the future, outstandingly successful. The United Nations Educational and Cultural Organisation would also encourage the setting up of such unions in sciences which have not previously had them It would also encourage the activities of such essential organizations as the International Committee on Zoological Nomenclature.

(11) Support all international activities of the various national academies of science.

This simply emphasizes the desirability of working in close co-operation with such bodies as the Roya Society, the Paris Academy of Sciences, the U.S National Academy of Sciences, the Academy o Sciences of Moscow, etc.

(12) Assist the work of other international organizations, such as the United Nations Food and Agriculture Organisation, the International Labour Office, the International Health Organisation, the United Nations Relief and Rehabilitation Administration, etc., in scientific questions.

At first sight this seems to need no comment since the means of mutual assistance would grow up naturally between these bodies. But mention may be made here of certain bodies which may play a very important part in world science without being international in the widest sense. Thus the British Commonwealth, now the War is practically over, wil almost certainly possess a science co-operation service of its own, with a central secretariat in London and permanent offices in all the other capitals, for example Delhi, Canberra, Ottawa, etc. This would be a federation within a federation, and its existence would enormously lighten the work of scientific co-operation since the British Commonwealth could be treated as one unit. The United States and U.S.S.R. do not present such problems on account of their territorial contiguity and unity.

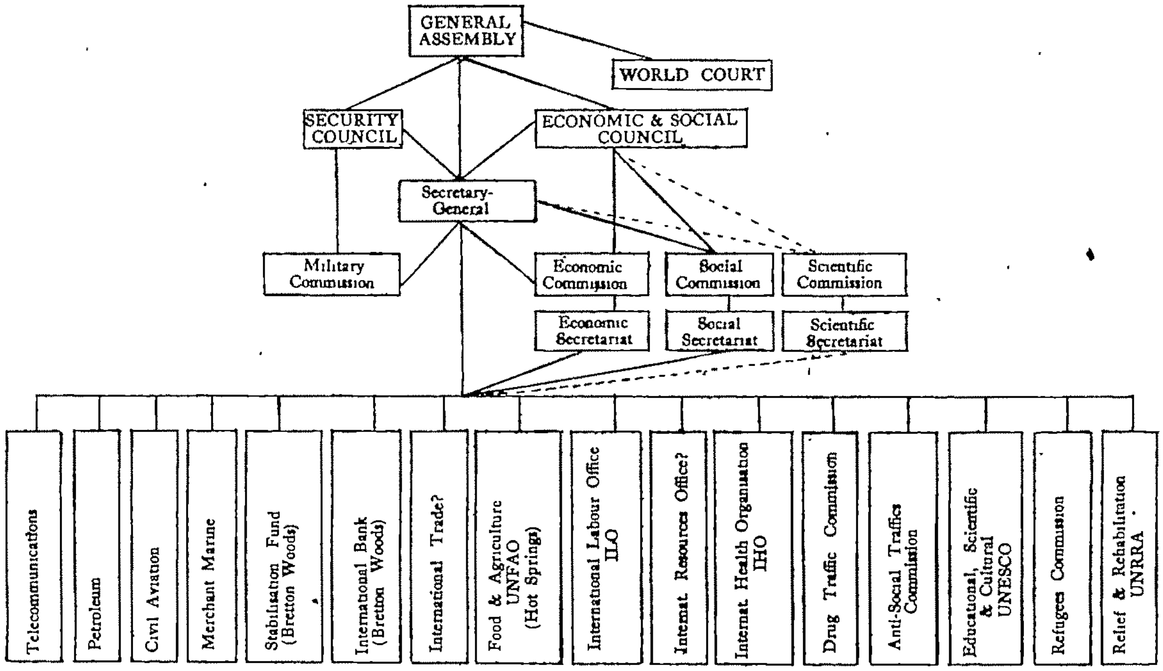
In the field of agriculture, what is essentially a British Commonwealth science co-operation service has led an extremely successful existence since 1929 under the name of the Imperial Agricultural Bureaux

(13) Combine into branches of one organization, i feasible, the smaller international scientific bodies already existing.

A Scientific Commission and Secretariat

In all the foregoing discussion, it has been assumed that the principal place for science in the international scheme would be the United Nations Educational and Cultural Organisation But although this body has seemed the obviou home for an International Science Co-operation

UNITED NATIONS WORLD ORGANISATION


GENERAL ASSEMBLY
WORLD COURT
SECURITY COUNCIL
ECONOMIC & SOCIAL COUNCIL
Secretary-General
Military Commission
Economic Commission
Social Commission
Scientific Commission
Economic Secretariat
Social Secretariat
Scientific Secretariat
Telecommunications
Petroleum
Civil Aviation
Merchant Marine
Stabilisation Fund (Bretton Woods)
International Bank (Bretton Woods)
International Trade?
Food & Agriculture UNFAO (Hot Springs)
International Labour Office ILO
Internat. Resources Office?
Internat. Health Organisation IHO
Drug Traffic Commission
Anti-Social Traffics Commission
Educational, Scientific & Cultural UNESCO
Refugees Commission
Relief & Rehabilitation UNRRA

Service, it must be remembered that a considerable number of men of science will be working with the other functional organizations, such as the envisaged Radio Communications Organisation, the Civil Aviation Board, the Food and Agriculture Organisation, the Petroleum Board, the International Health Organisation and the Drug Traffic Commission.

Another proposal, of great importance, therefore deserves discussion. The services which science could render to world organization are so substantial, and at the same time so unpredictable, that it might be desirable to introduce a scientific body at a higher level than any one of the functional organizations.

Let us look for a moment at the Dumbarton Oaks proposals (see accompanying diagram). From the General Assembly there will stem on one hand the Security Council for military and political matters five great Powers *ex officio* and six elected governments). This will not immediately concern us further. On the other hand, there will stem the Economic and Social Advisory Council (eighteen governments elected freely by the Assembly). This Council is to have an Economic Commission and a Social Commission with their respective secretariats "and such other Commissions as may be necessary". Why hould it not also have a Scientific Commission and Scientific Secretariat ?

A World Conference of Science

There can be no doubt that among those concerned with government and international relations there is general desire to see science well represented, and in a manner satisfactory to its representatives. The various proposals in this memorandum are brought orward as an aid to discussion. Others have been, and will be, forthcoming. There is available much arefully thought-out material embodying useful experience in crystallizing the structure of international organizations. But nothing authoritative can be obtained without a world conference of science, organized along the same lines as Bretton Woods, Hot Springs and Dumbarton Oaks. This should be called together as soon as possible. Only in this way can the voice of world science clearly indicate its wishes and aspirations with regard to the organization of the International Science Co-operation Service and the United Nations Educational and Cultural Organisation.

Summary

(1) An International Science Co-operation Service has been proposed. It is shown that there are immense tasks to be undertaken for the benefit of humanity through the rapid expansion and dissemination of knowledge, by such an organization.

(2) The United Nations Educational and Cultural Organisation now being planned could embody the machinery proposed above, subject to certain conditions being met. A formulation of the tasks before any science division of the United Nations Educational and Cultural Organisation is given.

(3) Science has so much to offer to world organization that it would be highly desirable if it were represented at the higher, or conciliar, level, as well as at the lower, or functional organization, level. A proposal is made for a Scientific Commission to take its place, with its corresponding secretariat, side by side with the Economic and Social Commissions and their secretariats, in assisting the work of the Economic and Social Advisory Council. This arrangement would provide a means for correlating the entire scientific work of the whole world organization, and affording means of contact between the men of science in the various functional organizations.

(4) In order to ensure that all arrangements made shall be to the greatest benefit of world science, and hence to the welfare of the peoples, it is necessary that a world conference of men of science and their organizations should be called to assemble at some convenient place as soon as possible.

PHYSICS AND ASTROPHYSICS AT THE IMPERIAL COLLEGE

By Prof. HERBERT DINGLE

DURING the past hundred years, the Colleges now amalgamated in the Imperial College of Science and Technology have been prominently associated with both the dissemination and the acquisition of knowledge in the physical sciences. The Royal School of Mines numbers among its professors of physics men like Stokes (1854–60) and Tyndall (1860–68), whose names stand in the forefront of Victorian physics and whose influence on their students, less easy to appraise than their personal contributions to research, was no less important in the maintenance and development of physical science on both its theoretical and practical sides. Tyndall was succeeded by Guthrie (1868–86), whose creation of the Physical Society of London (now the Physical Society, one of the most active and influential scientific societies in the country) in 1873 places him among the greatest benefactors whom this department of science has known. The Society, which at first met in Guthrie's rooms at South Kensington, later met regularly at the Royal College of Science and still continues frequently to do so. Its membership has a steady source of supply in the graduates of the College, and the association indeed is so intimate that there is scarcely an activity of the Society in which the College cannot claim some measure of participation.

A comparable influence is that of Mr. (later Sir) Norman Lockyer who, by his founding of *Nature* in 1869, provided a much-needed medium through which men of science could communicate to one another and to the world generally the results of their researches. After fifty years of continuous service, Lockyer passed on the office of editor to his former pupil Gregory (now Sir Richard Gregory, Bart.) who received his early training, and later assisted with the teaching, at the Royal College of Science. Gregory edited *Nature* for twenty years, so that for seventy of the last hundred years it may be said in this place without lack of modesty that the leading scientific journal of the world was established and guided by men whose scientific activities are part of the history of the Royal College of Science.

When, in 1868, Lockyer sprang overnight into fame by the dramatic circumstances of his discovery of the nature of solar prominences and the consequent birth of the science of solar physics, he was not a member of the College staff but a clerk in the War Office. He immediately established relations, however, with the College which he was later to adorn by entering into collaboration with Frankland, then professor at the College of Chemistry in Oxford Street, the foundation of which in 1845 makes the present year the centenary year of the Imperial College*. Lockyer had observed in the spectrum of the solar prominences and of the chromosphere, which he discovered and named, the lines of hydrogen and also an unknown yellow line which he was anxious to identify. He realized at once that thenceforth astronomical and laboratory observation must go hand in hand, and with Frankland's assistance he inaugurated a programme of research of the type which is now universally recognized as indispensable to the successful study of astrophysics. They worked in the evenings —the only time during which Lockyer was free—with the assistance of two young men, Pedler and McCleod, who later themselves became distinguished as Sir Alexander Pedler and Prof. H. McCleod. The physical conditions in the chromosphere were deduced from the characteristics of the spectrum lines of hydrogen, in the light of the changes which had to be made in the laboratory to produce those characteristics. The yellow line, however, could by no means be produced, and Lockyer soon came to the conclusion that it arose from an unknown element, to which he gave the name 'helium'. Not for twenty-seven years was helium discovered on the earth; but in the meantime Lockyer had learned a great deal about its character from a study of its behaviour in the sun (other lines besides the yellow one were soon recognized as probably arising from the same source), and to-day it is generally acknowledged that the importance of helium in the scheme of things would be difficult to exaggerate.

In 1870, a Royal Commission under the chairmanship of the Duke of Devonshire was appointed to inquire into the means by which State aid could more effectively advance science and scientific instruction in Great Britain and Ireland. Lockyer was appointed secretary to this Commission, and as one result of its activities the Royal College of Chemistry and the Royal School of Mines were united under the name of the 'Normal School of Science' (later changed to 'Royal College of Science') and established at South Kensington. The Commission sat for five years, and in its final report it expressed the hope that "some arrangement may be made by which the services of Mr. Lockyer in the promotion of science may be secured to the country" The ultimate result of this recommendation was that the Solar Physics Observatory (now transferred to Cambridge) was created under Lockyer's direction at South Kensington, and he was appointed in 1881 as lecturer, and in 1887 as professor, in astronomy at the Normal School of Science. From that time unti his retirement from the College in 1901, the activitie of the Observatory and of the College were closely connected.

During this period the work at South Kensington stood in the forefront of astronomical physics. O Lockyer's two outstanding ideas, that of the 'meteoritic hypothesis'—the theory that the heavenly bodies originated in meteors the gradual aggregation and subsequent development of which constitute th evolution of the physical universe—has not stood th test of time; though in some respects—such as th deduction that stars, starting as cool bodies, becom hotter and pass through a maximum temperature to cool state again—it later received on independen grounds a degree of approval for which Lockye fought vainly in earlier years. The other idea, however—that of 'dissociation'—was truly prophetic. O spectroscopic evidence Lockyer argued, with complete justification, that we must recognize that atom and molecules are not eternally unchangeable entities, but that they can be and are broken up int simpler forms which yield different spectra. Th character of the dissociation it was scarcely possib to conceive in the absence of any theory of atom structure; but on the main point, Lockyer, thoug he stood almost alone, was perfectly correct.

From 1885 onwards Lockyer had as his assista Alfred Fowler, a young student of great ability astronomical and spectroscopic work. Fowler su ceeded Lockyer in the conduct of the work at the Royal College of Science, and immediately distinguished himself by a succession of identifications of previously unknown features of celestial spectra. The TiO bands in the spectra of red stars, the CO bands in the spectra of comets' tails, and the 'cosmic hydrogen' lines are outstanding examples. Fowler's real opportunity came, however, when in 1913 Bohr initiated the modern theory of the origin of spectra. Fowler's familiarity with the spectra of the elements and their variation with physical conditions was unrivalled, and he immediately saw in the Bohr theory the explanation of facts with many of which he alone was acquainted. What Lockyer had described as 'dissociation' was now seen to be 'ionization', and the successive spectra of an element which Fowler had sorted out and classified on experimental grounds were identified as spectra of atoms at successive stages of ionization. As the theoretical possibilities of analysis developed, Fowler applied them to his store of experimental data, and for some years the College made outstanding contributions to the most rapidly developing and fundamentally important branch of physical research. Pupils came from various parts of the world, as well as from among College graduates, and, to mention but two examples, Saha's thermodynamical theory of stellar atmospheres and Catalan's discovery of the existence of multiplets originated in Fowler's laboratory. Experimental spectroscopy may truly be said to have been born and matured at the Royal College of Science. Fowler himself, after his appointment as one of the first Yarrow research professors of the Royal Society, continued to work and direct research there.

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* See also *Nature* of Nov. 3, pp. 518–527.

Another branch of study in which the College has figured prominently is that of colour physics. This was begun as early as 1877, when Captain (later Sir William) Abney set up his laboratory in one of the temporary buildings at South Kensington which at that time were the only accommodation available to the Normal School of Science. The work has continued until the present time, and now forms an important part of the College's contribution to physical research. Abney's colour-patch apparatus was a pioneering effort in experimental research in this field, and it was applied not only to fundamental investigations but also to the testing of the colour vision of recruits for the Royal Navy and other services in which this physical characteristic is of importance. In photographic work also, particularly in the infra-red, Abney was a pioneer, and his emulsions for this region of the spectrum still defy reproduction. If the story that he photographed a kettle of boiling water in the dark by means of its temperature radiation is authentic, it was at the College that the work was done. In more recent years the Abney apparatus has been superseded by the Wright colorimeter, also a product of the College, and active research is carried on not only into the peculiarities of various types of colour vision, in which valuable assistance is given by the Medical Research Council, but also into many aspects of colour which affect problems of illumination and the dyeing and other industries.

For twenty-one years, from 1876 until 1897, the College was the scene of activity of one of the great experimenters of the time—Mr. (later Sir) C. V. Boys. Of his numerous achievements, all bearing the stamp of great ingenuity and experimental skill, it will be sufficient to recall his determination of the constant of gravitation with a small laboratory apparatus; his invention of the radio-micrometer, the most sensitive instrument yet devised for the detection and measurement of radiant energy; the production and discovery of the properties of quartz fibres which he made by firing white-hot molten quartz with an arrow from a bow; and the photography of lightning and of bullets in flight. All Boys's work was characterized by the combination of extreme accuracy and sensitivity with compactness of design. His genius was essentially individual and there was no possibility of his founding a school; but he had a keen eye for choosing the right man for a job, and he established a tradition which extends his influence beyond the direct effect of his own achievements.

During the earlier part of the present century, the Physics Department was under the direction of the late Prof. H. L. Callendar, whose work in temperature measurement and various other branches of heat and thermodynamics has become classical. The present chairman of the Governing Body, Lord Rayleigh (then the Hon. R. J. Strutt), was also at that time a professor of the College, and carried out much of his well-known work on radioactivity and discharges in gases. Callendar, like Boys, had a genius for exact measurement, and under his guidance and that of his collaborator, Prof. W. Watson, a succession of students received a training in habits of precision which has had no small influence on the successful application of physics to industrial affairs during the last forty years. It would be difficult to estimate, for example, how much Callendar's example and influence have contributed to the achievements of the National Physical Laboratory since its establishment. Some of the most outstanding members of the staff of that institution owe their physical knowledge and methods of research to his training.

During Callendar's professorship, the practice was begun of establishing sub-departments of the Physics Department for the advancement of certain specialized subjects. Astrophysics, already mentioned, became after Lockyer's retirement one such department which is still very active, and a Technical Optics Section was later added. This Section originated during the War of 1914–18 as a separate department, intended to be a source of production of optical designers, the lack of whom in the country during the War was felt as a serious disability. It was later brought under the general control of the head of the Physics Department, and it now covers a wide field of research and training in various aspects of optical work. An associated sub-department of Instrument Design has performed a useful function, and its reorganization as an independent department is now under consideration. Meteorology has pursued the opposite course to technical optics. Beginning in 1920 as a branch of physics, with a part-time chair, which has had such distinguished occupants as the late Sir Napier Shaw and Sir Gilbert Walker, it became a separate department in 1934 with a full-time professorship. Courses are given to students who have graduated in physics at the College or have had an adequate training elsewhere, and research into various problems of climate and weather is carried on. The most recently established sub-department is that of Geophysics, where, in the only postgraduate school of its kind in the country, students are trained in the principles of prospecting and other geophysical work.

Under the present head of the Department of Physics, Sir George Thomson, research in electron diffraction and nuclear physics is conducted. This is so much a matter of common and vital interest at the present time that it needs no emphasis here. The work of the College was specifically mentioned in Mr. Churchill's original statement on the atomic bomb, when for the first time the leading part played in the matter by Sir George Thomson's Committee was made known. Physics at the Imperial College begins its second century in most auspicious circumstances, and, granted the support to which its record entitles it, the future should witness no abatement of its influence both in pure research and in the application of physical knowledge in the widest possible field.

NEWS and VIEWS

Atomic Energy and Scientific Freedom

SINCE the opinions on atomic energy expressed in the leading article beginning on p. 547 were written, several important pronouncements in this connexion have been made. In the past, statements have been published from many sources and some of these, especially those attributed to Mr. Truman, have not only misled the general public, but have also caused irritation to many men of science in general and those who have kept in touch with research in atomic physics, especially since 1934, in particular. M. Molotov's claim in his speech in Moscow, on November 6, that the Soviet Union will soon "have atomic energy and many other things" will come as no surprise to men of science. On the other hand, it will probably stimulate second thoughts in others (and there are many) who have been inspired to believe that while the so-called 'secrets' of the atomic bomb remain vested in Britain, the United States and Canada, the world is safe.

Prof. M. L. Oliphant's vigorous speech at Birmingham on November 3 was also timely. As he stated, it is not possible to "deal with this job by a secret meeting between Mr. Attlee and President Truman. This is so big, so important, and so vital to the world, that it has to be done in the open". The recent statement from the Soviet Union confirms Prof. Oliphant's view that the value of the 'secret' held by the Allies is about six months effort on the part of any industrial country. A more vigorous and concerted effort on the part of all men of science to keep science free and intercourse between men of science open and world-wide is essential if the science of atomic energy, and most probably other branches of science eventually, are not to sink into the slough of international political intrigue. Science must not be allowed to become a tool in the hands of anyone, certainly not a part of any nation's foreign policy, for if ever it does then the consequences may prove to be the most serious in the history of science, indeed of the world.

At a joint conference of the World Unity Movement and the Council for World Airways (both organizations with offices at 20 Buckingham Street, London, W.C.2) held at the City Literary Institute, London, on November 2, Sir Leonard Hill, Prof. Lancelot Hogben, Dr. Kathleen Lonsdale, Prof. Lionel Penrose and Mr. Ritchie Calder, among others, spoke on the implications of the recent developments of atomic energy in relation to international affairs and the freedom of science. The following resolution, moved by Mr. Caradog Jones, was passed by the meeting: "Believing that no scientific knowledge should or can willingly be kept secret this Conference urges that the development of atomic energy be made subject without delay to international control and that the advice and co-operation of scientists be sought in order to devise the best means to exploit its use under a world authority solely and fully in the interest of the world community".

Nobel Laureates in Medicine

MEN of science will welcome the announcement that the Nobel Prize for Medicine for 1945 has been awarded jointly to Sir Alexander Fleming, Sir Howard Florey and Dr. E. Chain. Sir Alexander Fleming is now professor of bacteriology in St. Mary's Hospital Medical School, London. During the First World War, when he was working upon the bacteriology of septic wounds, Fleming became convinced that the chemical antiseptics then in use were often very harmful to the leucocytes which attack bacteria, and he discovered, in 1922, lysozyme, an antibacterial ferment which occurs in many animal tissues and secretions. In 1924 he showed that, if the antileucocytic power of an antiseptic is greater than its antibacterial power, it is not likely to be therapeutically valuable. When, therefore, he published in 1929, six years before the announcement by Domagk of the discovery of the sulphonamides, the discovery of penicillin and an account of his early trials of its antibacterial action, it was evident that he had provided us with an antibacterial agent which was not only powerfully antibacterial against some of the most pathogenic of organisms, but was also not toxic to the all-important antibacterial leucocytes and also not toxic to the animal infected with them. Attempts made at that time, however, to extract a form of penicillin which could be used therapeutically were not successful, and it seemed that this remarkable antibacterial agent would be denied to man.

The stage had, nevertheless, been set for the later work at Oxford of Sir Howard Florey and Dr. E. Chain, and it is interesting to note that the earlier work of these two investigators, like that of Sir Alexander Fleming, had predisposed them to make the particular and all-important contribution to the main problem which they made. Sir Howard Florey is now professor of pathology in the University of Oxford. Since the 1920's he has been interested in problems of bacterial inhibition, and he has studied Fleming's lysozyme. The original discovery that some organisms produce substances which inhibit or prevent the growth and multiplication of other organisms was made by Pasteur and Joubert in 1877, and in 1899 Emmerich and Loew had extracted pyocyanase from *B. pyocyaneus*. When the Oxford work on antibiotics began in 1938, pyocyanase and penicillin were selected for study. Florey now had at hand the assistance of Dr. E. Chain, University demonstrator in chemical pathology at the Sir William Dunn School of Pathology, a man whose studies of enzymes and of the isolation from natural sources of substances which are physiologically active has earned him distinction. Dr. Chain (though of Russian extraction) was born in Berlin and received his early training at the University there. He came to Britain in 1933 and was appointed to the staff of the Sir William Dunn School of Pathology in 1935.

The success of this collaboration is now well known.

ss well known—outside scientific circles, at any te—is the full story of the remarkable work of e team of experts which was afterwards formed Oxford for the study of the production, therautic use and mode of action of penicillin. Some y perhaps we shall have the human, as well as e scientific, story of this work and we shall then alize to the full the achievement of the many men d women who, working under the three leaders om the Nobel Prize so deservedly honours, have en to mankind, not only penicillin, but also the ole volume of the later work on antibiotics which s opened a new chapter in the history of the fight ainst disease. To these others their leaders have en acknowledged their debt.

nited Nations Educational and Cultural Organisation: Scientific Delegates

AMONG the delegates to the United Nations nference now meeting in London to discuss the tablishment of an Educational and Cultural ganisation (see pp. 553–561) are the following men science: *United Kingdom,* Dr. E. F. Armstrong, viser to the delegates of H.M. Government; *nada,* Dr. R. C. Wallace, principal of Queen's iversity, Kingston, formerly professor of geology d mineralogy in the University of Manitoba, and . J. G. Malloch, chief scientific liaison officer ondon) of the National Research Board of Canada; *nited States,* Dr. Harlow Shapley, director of Harvd Observatory (due to arrive shortly), and Dr. orge Stoddard, the child psychologist and comissioner of education for the State of New York; *ance,* Prof. Joliot-Curie and Prof. Auger, both ofessors of physics in the Sorbonne; Prof. H. ugier, professor of physiology in the Sorbonne, d Prof. Wallon, professor of psychology in the llège de France; *China,* Mr. Li Shu-Hua, physicist the Research Institute of Peiping, and Mr. Wang ng-Shi, director of the Chinese Institute of Psychoy, (the head of the Chinese delegation, the geologist . Chu Chia-Hua, is not likely to arrive in time); *therlands,* Prof. H. R. Kruyt, professor of physical emistry in the University of Utrecht; *Belgium,* of. G. Magnel, professor of civil engineering in the iversity of Ghent; *Norway,* Dr. Olaf Devik, ysicist, and Dr. Ellen Gladitsch, chemist; *Poland,* f. Mikolaj Olekiewicz, professor of biological and thematical statistics in the University of Lublin; *rkey,* Prof. Omer C. Sarc, professor of economics the University of Istanbul, and Prof. Ratip Berker, fessor of mechanical engineering in the University Istanbul.

w Television System

N October 31, Messrs. Pye, Ltd., gave a demonstra- at Cambridge of a new television system recently eloped by a research team under Mr. D. I. Lawson. novel feature in this system is the utilization of 'fly-back' times in the scanning sequence, during ich the transmitter would otherwise be idle, to ommodate short pulses the duration of which can modulated by the sound accompaniment of the vision programme. At the receiving end, these lth-modulated pulses are filtered out of the total nsmission by an amplitude-selection process. Thus ngle frequency channel is made capable of conveying h the vision and sound simultaneously; hence name 'Videosonic' which has been given to the tem.

With the standard type of 405-line scanning in use in Britain before the War, the fly-back time is 10 microseconds, occurring 10,125 times a second. This pulse-repetition frequency limits the audio-frequency range to something less than a high-fidelity standard, but a subsidiary demonstration showed that a 1,000-line system would enable a very satisfactory audio-frequency range to be transmitted. The use of a single channel has obvious advantages in view of the demand for space in the radio spectrum, but from the commercial point of view the chief potential advantage of the 'Videosonic' system is the cheapening of television receivers. The system also offers some interesting possibilities for future development; in particular the location of twin pulses in the fly-back space could be used for stereophonic sound, and the superposition of a sequence of amplitude changes on the width-modulated pulses might be used as a means of controlling a triple-scanning sequence for television in colour.

Danish Research Expedition

ON November 1, the Danish research vessel *Atlantide* left Plymouth en route for the coast of West Africa. The ship left Copenhagen on October 3 and, after being held up by bad weather, reached Plymouth on October 30. The vessel, a three-masted schooner which once sailed under the well-known name of *Shenandoah,* is owned by the Danish sculptor, Mr. Viggo Jarl, who has lent her to the Danish Government for marine research and is paying all expenses. Dr. Anton Fr. Bruun of the Copenhagen University Museum, who has made many cruises in the *Dana,* is leading the expedition; he has with him two young Danish zoologists, Jorgen Knudsen of the Royal Danish Veterinary College, and Torben Wolff. The British Museum (Natural History) is represented by Dr. F. C. Fraser, and the vessel will pick up Dr. G. R. Howat, Government chemist, at Accra. The route to be followed covers the whole of the coast of West Africa to the Cape, and includes the Ascension Islands and St. Helena. The expedition is intended primarily to make a zoogeographical survey along that coast. Sections will be made outwards from the coast to deep water at intervals, the main region of interest lying between the Congo and Walfisch Bay, an area from which little collecting has been done. The vessel is equipped for collecting with Petersen and Feen grabs, shrimp trawls and plankton nets of various sizes; she also carries a small harpoon gun. The voyage is expected to last about eight months, and it is hoped that much valuable material will be collected for the Danish and British Museums. This is the first marine expedition to leave the coasts of Europe since the War ended, and the Danes are to be congratulated on acting so promptly in starting the exploration of the sea once more.

Queen Victoria Memorial, Salisbury, Southern Rhodesia

THE annual report, for the year ended March 31, 1945, of the Queen Victoria Memorial, Salisbury, Southern Rhodesia, indicates that owing to the difficult conditions with which publishers in Great Britain are faced, the limitation of the number o copies of books, and the irregular arrival of mails from overseas, the supply of books for the library continues to decrease. In the meantime, the demand for certain cultural and technical literature is being met so far as is possible, but no improvement in the position is expected for some considerable time to come. Of the Salisbury Museum, the Committee reports that in spite of difficulties relative to exhibition and working space, specialization in certain branches of science continues.

Summer School in X-Ray Crystallography at Cambridge

For the third year in succession, members of the Department of Mineralogy and Petrology and the Cavendish Laboratory at Cambridge were able, through the courtesy of Prof. C. E. Tilley and Sir Lawrence Bragg, to conduct a summer school in X-ray crystallography; the administration was under the control of the Board of Extra-Mural Studies. The first part of the course, which was attended by everyone, dealt with crystal symmetry and the use of stereographic and gnomonic projections. Then followed fundamental theory and practice in the interpretation of the various types of X-ray photographs, the production and properties of X-rays and the measurement of intensities of X-ray reflexions. The methods of taking, interpreting and using powder photographs were dealt with in some detail. The school differed from those previously held in that during the last two days it was divided into two groups (as it happened, into almost equal numbers), one of which studied further theory and practice in the elucidation of fundamental crystal structure, such as the theory of space groups, structure factors, use of absent spectra to determine space groups and parameter determination; the second group studied powder photographs in relation to metallurgical problems such as the determination of grain size, stress and the orientation of crystals in drawn wires and rolled sheets. Throughout the course the labour of computation was greatly reduced by the use of graphical methods and the provision of tables in which many of the factors in formulæ had already been worked out. Of the thirty-one who attended the course, eight were from universities, two from research institutes, one from a technical college, two from research associations, three from Government laboratories and fifteen from industry. The opportunity for interchange of ideas afforded (especially at tea served in the laboratory after the day's work) was one of the most valuable aspects of the course. The success of these schools at Cambridge should encourage other authorities to develop this aspect of university education.

Institute for the Study of Animal Behaviour

At a meeting of the Council of the Institute for the Study of Animal Behaviour on October 16, at the Zoological Society of London, Dr. E. Hindle, scientific director of the Zoological Society, was elected president in succession to Dr. E. S. Russell, who had resigned and who was made an honorary member and re-elected a member of Council. The following were also re-elected members of Council: Mr. R. J. Bartlett, Dr. J. T. Edwards, Mr. J. W. B. Douglas (*Hon. Asst. Editor*), Mr. J. M. McC. Fisher, Dr. J. Hammond, Dr. E. Hindle, Dr. J. Huxley, Dr. G. Lapage, Dr. W. H. Thorpe, Dr. A. Walton, Prof. A. N. Worden (*Hon. Secretary-Treasurer*), Prof. S. Zuckerman (*Hon. Editor*). Dr. A. Landsborough Thomson, Prof. James Gray, Dr. B. W. Tucker and Mr. David Lack were invited to attend to discuss Dr. W. H. Thorpe's proposal that a small field station for work on bird behaviour be initiated under the direction of the Institute. This proposal was welcomed, and Dr. Thorpe was entrusted with the pr paration of working details of his scheme. The futu of publication in Europe of matter relating to anim behaviour was discussed also in the light of a con munication from Dr. N. Tinbergen, of the Zoologic Laboratory of the University of Leyden. The Counc agreed to support any claims for the financing work on behaviour among domestic animals, f example, on grazing behaviour in ruminants and sexual behaviour in bulls. It was agreed to hold th next scientific meeting of the Institute early in 194

University of London

Dr. G. A. H. Buttle has been appointed to th University chair of pharmacology tenable at th College of the Pharmaceutical Society of Gre Britain as from October 1.

The following titles have been conferred: profess of electrical engineering on Dr. H. E. M. Barlo who has been reader in electrical engineering University College since 1938; reader in analytic chemistry in the University on Mr. L. S. Theobal in respect of the post now held by him at Imperi College of Science and Technology; reader i nutritional science in the University on Dr. Glad A. Hartwell, in respect of the post now held by her King's College of Household and Social Science.

Announcements

Dr. A. B. Stewart, deputy director of th Macaulay Institute for Soil Research, Aberdeen, ha been granted leave of absence for six or seven mont to advise the Government of India upon the orga ization and conduct of research and field experiment tion upon problems of soil fertility and crop pr duction. Dr. Stewart has in recent years devote much time to problems of soil fertility in relation t both plants and animals.

The Medical Research Council has appointed th following to be members of its Industrial Healt Research Board until August 31, 1948: Prof. F. Bartlett (*chairman*), Dr. A. N. Drury, Prof. Ferguson, Lord Forrester, Prof. A. Bradford Hi Dr. D. Hunter, Prof. Esther M. Killick, Prof. R. Lane, Prof. J. M. Mackintosh, Dr. E. R. A. Mer wether, Prof. J. A. Ryle and Mr. J. L. Smyt (Dr. R. S. F. Schilling, seconded to the Council headquarters staff from the Factory Department the Ministry of Labour and National Service, co tinues to be secretary of the Board.)

The directors of Messrs. H. K. Lewis and C Ltd. (Medical Publishers, 136 Gower Street, Londo W.C.1), are considering adding foreign medical a scientific books to their lending library. In order assess the possible demands for such books, questionnaire is being circulated to men of scien and medical men. Copies of this can be obtained fro Messrs. Lewis at the above address.

A Conference on "The Training, Qualificatio and Function of Dietitians" will be held by t Nutrition Society on November 17, beginning 11 a.m., at the London School of Hygiene a Tropical Medicine, Keppel Street, W.C.1. No members desiring to attend this meeting should app to a member of the Society for a ticket of admissio Further details of the Nutrition Society can obtained from the Hon. Secretary, Dr. Leslie Harris, Nutritional Laboratory, Milton Road, Ca bridge.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

The Raman Effect in Rocksalt

THE theory of the Raman effect in crystals, as ound in the literature, is rather unsatisfactory. part from some general symmetry considerations, the only attempt known to us of establishing definite ormulæ is that by Fermi and Rasetti[1] who gave the orrect expressions in a general way for explaining the observations on rocksalt. These observations made by Rasetti[2] show clearly a continuous spectrum with small superimposed eaks. The theory mentioned explains this eneral aspect satisfactorily; but Fermi and Rasetti find the formulæ too complicated for uantitative discussion.

We have taken up the same problem again ecause these same observations have been used y Raman and his pupils as an argument against ttice dynamics and in favour of their own theory of lattice vibrations. The latter contends that a crystal lattice has a vibration spectrum f a small number of frequencies, in contradiction to elementary laws of classical or quanum mechanics, according to which the number f vibrations of a system of N particles is $3N$, ence quasi-continuous for a crystal of finite imensions (N large).

Krishnan[3] interprets Rasetti's published reroduction of the Raman spectrum as a line pectrum of nine Stokes lines (and nine anti-Stokes lines), neglecting the very strong background ffect. This is rather strange, since the publication of he Italian authors also contains a photomicrograph f the density distribution, which shows that the ontinuous background is an essential feature. The riginal picture is reproduced herewith (Fig. 1).

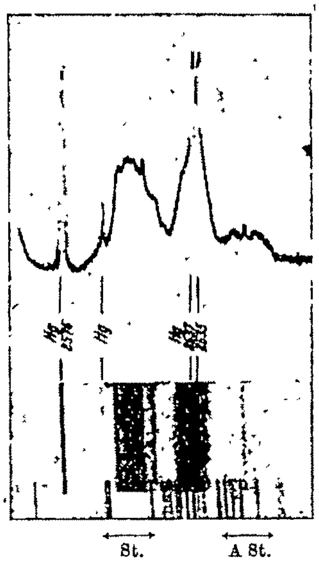


Fig 1. LOWER: PHOTOGRAPH OF RAMAN SPECTRUM SHOWING FAINT LINES ON BACKGROUND. ST, STOKES LINES. A.ST., ANTI-STOKES LINES. UPPER PHOTOMICROMETRIC CURVE OF INTENSITY DISTRIBUTION, SHOWING THAT THE APPARENT LINES ARE SMALL PEAKS ON A STRONG BACKGROUND

Krishnan further states that the number of lines (nine) is in agreement with Raman's theory; but he makes no attempt to compute the frequencies and intensities of these nine 'lines'.

In these circumstances we thought it necessary to work out the complete theory of the Raman effect in crystals and apply it to the case of rocksalt. This substance is particularly suitable, as Kellermann[4] has worked out the vibration spectrum in detail. His numerical results are independent of any arbitrary constants and are based only on the measured values of the lattice constant and compressibility. Using these results, we have derived the Raman spectrum, which is in this case a second-order effect with respect to the amplitudes of vibration, and we present the results in Fig. 2.

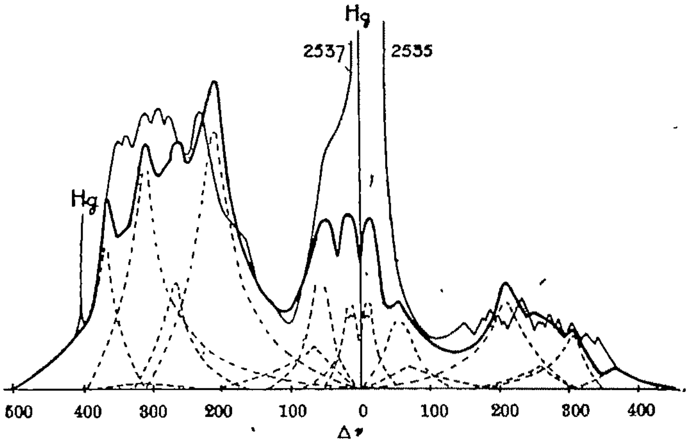


Fig. 2. FINE LINE REPRESENTS FERMI-RASETTI PHOTOMICROGRAPH (FIG. 1). BROKEN LINES ARE APPROXIMATE THEORETICAL CONTRIBUTIONS FROM PAIRS OF FREQUENCY BRANCHES. THICK LINE IS THEORETICAL CURVE FOUND BY SUPERPOSITION OF THESE.

It shows that the general features of the observations (continuous background with small peaks) come out very well from the theory. The range of the continuum and the positions of the maxima are obtained without any arbitrary assumptions, while the intensities are fitted to the experiment by adjusting some coupling constants. The formulæ for the intensities are so involved that we have picked out only the main terms. It is quite possible that further careful study would improve the agreement.

The Indian physicists have published new and valuable observations of a similar kind (on Raman effect and other optical phenomena in crystals) and have interpreted them as evidence for their theory. We are convinced that ordinary lattice dynamics will be able to explain these facts in a satisfactory way, though the calculations may be involved.

MAX BORN.
MARY BRADBURN.
Department of Mathematical Physics,
University, Edinburgh.
Aug. 26.

[1] Fermi, E., and Rasetti, F., *Z. Phys.*, 71, 689 (1931).

[2] Rasetti, F, *Nature*, 127, 626 (1931).

[3] Krishnan, R. S, *Proc. Ind. Acad. Sci.*, A, 18, 298 (1943).

[4] Kellermann, E W., *Phil. Trans.*, A, 238, 513 (1940).

The Editors, on receiving our communication, sent us the proofs of a new note by Prof. Krishnan on the same subject published in *Nature* of September 1.

It contains a reproduction and description of a new photograph which is certainly a considerable improvement on Rasetti's work. Krishnan interprets it in the same way as before, that is, as a line spectrum, because the little peaks, already visible in Rasetti's photomicrograph, have come out more clearly; but he again neglects the continuous background.

We have nothing to change in our opinion and only wish to add a few remarks. In the new photograph Krishnan finds six stronger and two weaker peaks; he seems to have given up the claim that the observations confirm the prediction from Raman's theory of exactly nine lines. In our theory the 'lines' are the density maxima of the combinations in pairs of the six branches of the frequency (six of the type 2ω, fifteen of the type $\omega_1 + \omega_2$, fifteen of the type $\omega_1 - \omega_2$); our figure contains only a few of these, which by adapting three coupling constants turn out to be the strongest. The superposition of these branches gives a most satisfactory qualitative picture of the observed curve; to reach perfect agreement a much better knowledge of the vibrational spectrum would be needed than is given by Kellermann, as well as sharper approximations in working out the complicated formulæ. This does not seem to be worth while.

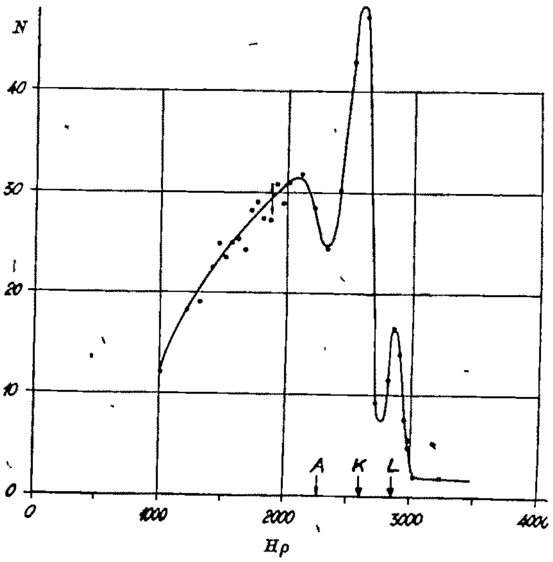
Concerning the infra-red absorption lines mentioned by Krishnan, the explanation given by Born and Blackman is only partly correct; the weak lines are indeed the density maxima of some of the pairs of branches, but the appearance of this combination spectrum does not depend on anharmonic terms in the equation of motion, but follows directly from the deformability of the ions, in the same way as the second-order Raman effect.

M. B., M. B.

Radioactivity of Active Nitrogen

INVESTIGATIONS of the radiations from the artificially active elements have been made with the help of the lens β-spectrograph, previously described[1]. It is of special interest to examine the β-spectra from the light elements, which, on account of their positions in the Sargent diagram, are due to permitted transitions. Among those elements there are only two, which, considering the short half-lives we have to deal with here, can be investigated with such an accuracy as to permit any conclusion, namely, carbon C^{11} and nitrogen N^{13}. Of these elements C^{11} has already been the subject of an investigation with the lens-spectrograph[2]. Nitrogen[3] is of special interest because of the fact that several authors[4] have found that the positron radiation is accompanied by a γ-radiation, caused by a complexity in the β_+-spectrum. On the other hand, some investigators[5] have not been able to detect this γ-radiation.

In order to study N^{13}, graphite was bombarded with deuterons (5 MeV.) in the Stockholm cyclotron. The half-value period for the active nitrogen was determined as 10·13 ± 0·10 m. by means of a Geiger-Müller counter plus a scale of eight, and also by an ionization chamber plus electrometer, the results obtained by the two methods showing good agreement. With the help of a special lock-device, the rather short-lived sample could quickly be brought into the β-spectrograph. To get a correct form of the energy distribution curve, it is important to avoid secondary radiation so far as possible. The window in front of the Geiger-Müller counter was less than 0·5 μ, which permitted an almost true reproduction of the spectr without any corrections for absorption even at ve small energies. The result from eleven differe series of measurements of the positron spectrum w plotted in a diagram. A separate investigation the upper limit was also made. This limit was determined as 1·24 ± 0·02 Mev.



In the Fermi formula for the energy distributio of the β-spectrum, there is a function $F(ZW)$, whic accounts for the influence of the Coulomb field of th nucleus upon the disintegration. It may be show that this function for light nuclei is approximate with good accuracy by $(1 - 1{\cdot}65\Delta^2)\, e^{\pi\Delta}$, whe $\Delta = \alpha Z \frac{W}{p}$, α is 1/137, W is energy, p momentum, Z is atomic number (with negati sign for positron emission). The Fermi diagram cu the abscissa at $W_{\text{max.}} = 1{\cdot}24$ Mev., in good agreeme with the direct determination. The departure fro the straight line occurs at $W = 0{\cdot}47$ Mev., a poi which evidently might correspond to the upper lim of the component with lower energy if the β_+ spectrum were complex. If we make a computatio of the transition probability according to the actu β-theory based on the fact that the lowest state o N^{13} and of C^{11} is a $^2P_{1/2,\,3/2}$-state we find, however, tha the intensity for the supposed component of lowe energy, if it exists, would amount to an almos negligible fraction of the component with the highe energy, due to the large difference between the uppe limits for the two components that our measurement would require. The departure from the straight lin might in fact be explained mostly by the inevitab secondary radiation, which originates in the sampl itself. If we plot $\left(\frac{N}{pW}\right)^{1/2}$ against $\sqrt{1 + p^2}$, w get, however, an absolutely straight line, whic furthermore cuts the abscissa at the same poi $W_{\text{max.}} = 1{\cdot}24$ Mev. Such a diagram might possibl be of use in attempts to separate the component in a really complex spectrum, when the sample are not exceedingly thin.

The illustration shows the result of an investigatio of the photo- and Compton-effect with lead as secondary radiator in the spectrometer. The curve show from the left to the right: the Compton effect for th annihilation radiation, the *K*- and *L*- photo-lines from the same radiation. The energy for the annihilaion radiation obtained from the curve is 0·515 ± 0·010 Mev., in good agreement with the value, which can be computed from mc^2, namely, 0·511 Mev. No γ-ray of the previously[4] reported energy of 80 kev. has been found by us, and according to our investigation the only γ-ray which accompanies he disintegration is due to the annihilation radiation.

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Åbo Akademi,
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Temperature Effect on Ultra-sonic Velocity in Water

VERY few systematic data exist so far relating to the effect of temperature on ultrasonic velocity in liquids, especially water. Loomis and Hubbard's results[1] for the change of ultra-sonic velocity in water and other liquids with rising temperature may be ited as perhaps the only systematic investigations, because earlier experiments[2] were carried out under rather unstandard conditions and in a very low region of sonic frequencies and therefore are not reliable. Even Hubbard's data for water are reported for a ery limited range of temperature, 0°–40° C., using a sonic interferometer at a frequency of 500 kc. only. The present work extends the knowledge of ultrasonic velocity in water up to a temperature of 70° C., using the method of diffraction of light by ultrasonics at a frequency of 5·7 mc./sec.

In this investigation the ultra-sonics were produced by a quartz crystal (diam. 22 mm., fundamental frequency 1·91 mc./sec.) which was cut and ground in this laboratory by me. The crystal was excited to its third harmonic at a frequency of 5·7 mc./sec. by applying the output from a one-valve oscillator (Hartley circuit), adjusted to the same frequency, to the two opposite faces of the crystal. For the production of ultra-sonics in water under investigation, the crystal was not directly immersed in water because of short-circuiting. The crystal was mounted in a small metallic cell containing xylol and having a nall leak-tight mica window in one face to let ultra-sonics pass through it. The cell containing the quartz crystal and xylol, and thus serving as a sort of source of ultra-sonic waves, was placed along one of the walls of a rectangular plate-glass vessel containing distilled and degassed water.

The plate-glass vessel with its contents was surrounded by a water-bath the temperature of which could be controlled and kept constant within 0·1° C. by a simple thermostat and relay; the water-bath was constantly agitated by stirrers, and the whole bath was enclosed in a double-walled wooden box loosely packed with sawdust. The temperature was read directly by a sensitive thermometer dipped in the plate-glass vessel.

The bath with its outer wooden enclosure had glass windows on two opposite faces which allowed parallel monochromatic light (green line λ = 5461 A. from a mercury arc) to pass at an incidence perpendicular to the direction of ultra-sonics generated in the vessel. A long focal length lens (f = 110 cm.) placed on the other side focused the emergent beam on a photographic plate which recorded the diffraction pattern for various temperatures of the water. Corresponding to each temperature from about 31° C. to 70° C. at intervals of 5° C., six independent photographic exposures were taken, and a mean of these six readings was used for calculation of the velocity at that temperature. Diffraction patterns were also recorded for temperatures at 75° C. and 80° C.; but these were too diffused, due to the constant shifting of density layers, to admit of any measurement without a considerable error.

The ultra-sonic intensity was kept fairly low (so that usually only two orders of diffraction appeared) in order to avoid the heating up of the liquid which results at higher intensities and disturbs the constancy of temperature.

The ultra-sonic velocity in water at various temperatures was calculated by comparing the distances of diffraction orders with those of pure xylol (Merck's) found with the same apparatus. The ultra-sonic velocity in xylol is a good standard, as almost every worker in the ultra-sonic field has worked it out independently; and hence the velocity is known to a fair degree of accuracy at several temperatures and frequencies.

The velocity in water at the various temperatures was found to be as follows:

ULTRA-SONIC VELOCITY IN WATER (FREQ. 5·7 MC./SEC.)

No.	Temperature ° C.	Ultra-sonic vel. (author) m./sec.	Ultra-sonic vel. (Hubbard) m./sec.
1	31·5	1510	1509·0 (at 30° C.)
2	35·1	1521	1520·6 (at 35° C.)
3	40·1	1531	1530·3 (at 40° C.)
4	45·4	1538	—
5	50·5	1545	—
6	55·4	1552	—
7	60·3	1553	—
8	65·3	1555	—
9	70·3	1557	—

My thanks are due to Prof. P. K. Kichlu for his interest in the work.

BAWA KANWAL SINGH.

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at the
Govt. College Physics Laboratory,
Lahore.
June 20.

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[1] Loomis and Hubbard, *Phil. Mag.*, (7), 5, 1177 (1928).

[2] Buss, *Ann. Phys.*, 75, 657 (1924). Dorsing, *Ann Phys.*, 25, 227 (1908).

Near Ultra-Violet Emission Bands of Benzene

THE ultra-violet emission spectrum in the region 3000–2475 A., obtained by Asundi and Padhye by high-frequency electrical discharge through benzene vapour[1], is probably more closely similar than the authors have realized to the fluorescence spectrum excited by Hg 2537 A. in benzene vapour at pressures which are not too low[2].

The authors point to a supposed difference of relative intensity in the various progressions labelled

A-F, giving the order *B, F, D, A, C* for the electrical, and *C, A, B, E, D* for the optical, method of excitation. Some confusion has, however, arisen, and it may be due to the fact that, when Sponer, Nordheim, Sklar and Teller[3] suggested their new basis for assignments in the ultra-violet spectra of benzene, they very properly changed Ingold and Wilson's labels. In any event, there appears to be no difference in the order of the intensities, which in both spectra agrees with the Boltzmann factors associated with the progressions.

The other supposed difference relates to the apparently shorter sequences in 160 cm.$^{-1}$ which appear in the electrically excited spectrum. However, the recognition of the nature and classification of the upper electronic state permits an assignment of fluorescence bands which avoids the assumed long sequences in 160 cm.$^{-1}$; and it now appears that with either type of excitation the upper electronic state is able to settle to something like a true Boltzmann distribution with respect to vibration and rotation. These and related matters will be discussed *in extenso* elsewhere.

C. K. INGOLD.

Sir William Ramsay and
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University College, London, W.C.1.
Sept. 30.

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[1] *Nature*, 156, 368 (1945).

[2] Ingold and Wilson, *J. Chem. Soc.*, 941, 955 and 1210 (1936).

[3] *J. Chem. Physics*, 7, 207 (1939).

Spectra of Diatomic Oxides by the Method of Exploded Wire

DURING recent years we have developed the method of the exploded wire with the view of its application to the study of molecular spectra, but the circumstances of the German occupation have prevented us from publishing the results. A full account of our investigations by this method (as well as by the method of the aureole of an arc) of FeO, NiO, CoO, CuO and CaO spectra will be given later in the *Bull. Soc. Roy. Sci. Liége*.

FeO. We studied the spectrum of FeO in the yellow during 1940 in collaboration with A. Delsemme, and extended our investigation to the blue and the photographic infra-red during 1942 with L. Malet. Four systems can be represented by:

$$\begin{array}{llr}
\nu = \left\{\begin{matrix}17908\\17808\end{matrix}\right\} - 875\,v'' + 5\,v''^2 + \left\{\begin{matrix}667\\660\end{matrix}\right\} v' & & \text{(System } A\text{)}\\
\nu = 17267 - 875\,v'' + 5\,v''^2 + 825\,v' & & \text{(System } B\text{)}\\
\nu = 22326 - 875\,v'' + 5\,v''^2 + 540\,v' & & \text{(System } C\text{)}\\
\nu = 12900 - 955\,v'' + 670\,v' & & \text{(System } D\text{)}
\end{array}$$

Two short isolated band series ending on the same lower level as the *A*, *B* and *C* bands indicate the existence of FeO electronic terms at 12,150 and 14,650 cm.$^{-1}$ above this level, which is probably the ground-level of FeO. The classification of the yellow doublets is the same as that proposed by Gaydon and Pearse[1].

NiO. We studied the spectra of NiO and CoO with L. Malet in 1942. For NiO nearly all the bands observed between 9,070 and 4,145 A. can be fitted into six systems. The constants are given in Table 1.

TABLE 1.

	ν_0	ω''	ω'
System I	12655	615	475
System II	13688	590	460
System III	16420	615	560
System IV	19314	825	590
System V	19602	820	590
System VI	21185	825	570

The state with $\omega'' = 615$ cm.$^{-1}$ is probably th ground-state of the molecule. The systems II, I and V are established with less certainty than th others.

CoO. Bands are observed between 5,000 an 10,000 A. The only characteristic frequency ω'' = 840 cm.$^{-1}$ can be attributed with great probabilit to the ground-state of the molecule.

CuO. The spectrum of CuO was investigated du ing 1942 in collaboration with J. M. Lejeune. Th vibrational analysis of the red CuO bands showe that they can be represented by:

$$\nu = 16222 - 625\,v'' + 3\,v''^2 + 274\,v' \quad \text{(System I)}$$

The green and blue bands observed previously b Hertenstein[2] can be represented by:

$$\begin{array}{lr}
\nu = 21570 - 625\,v'' + 3\,v''^2 & \text{(System II)}\\
\nu = 21824 - 625\,v'' + 3\,v''^2 + 510\,v' & \text{(System III)}
\end{array}$$

The lower state with $\omega'' = 625$ cm.$^{-1}$ is very prob ably the ground-state of the molecule.

CaO. This spectrum has been studied during 194 and 1944 in collaboration with J. M. Lejeune. Th main results are summarized in Table 2, which in cludes also the revised results of previous investig tions on this spectrum.

TABLE 2

	System α (Meggers I)	System β (Meggers II)	System γ (Orange bands)	System δ (Green bands)	System ε	System σ	Syste η
ν_e	9491	13679	15947	18260	25191	28054	293
ω''	637	711	640	780	711	711	
ω'	674	694	711	670	575	550	8.
$x''\omega''$	~7	~3 5	~5		~4	~4	
$x'\omega'$	~5	~5	~5				

The state with $\omega'' = 640$ cm.$^{-1}$ is probably th ground-state of the CaO molecule.

All the proposed ω''-values for the ground-stat of the molecules studied are in accordance with th empirical laws governing the ω''-values of diatom oxides.

The results of our investigation on the AlO spectru by the method of exploded wires, which enabled us establish several new systems of AlO and to study some detail the predissociation phenomenon emission spectra, have already been published[3,4].

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July 30.

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[2] Hertenstein, H., *Z. wiss. Phot.*, 11, 69, 119 (1912).

[3] Coheur, F., and Rosen, B., *Bull. Soc. Roy. Sci. Liége*, 405 (194

[4] Rosen, B., *Bull. Soc. Roy. Sci. Liége*, 176 (1944).

Chromatography of Two Solutes

WE regret that we cannot agree with the concl sions arrived at by Dr. Glückauf[1] and that even the case of the Langmuir isotherm they seem scarce plausible in the general case.

Our equations can be applied to any suitab adsorption isotherm. In the case of a single solu the concentration in the developed band is given our equation:

$$f'(c) = \frac{v}{x} \quad . \quad . \quad . \quad . \quad . \quad . \quad ($$

The corresponding equation for two solutes is:

$$\begin{vmatrix} f'_{c_1} - \dfrac{v}{x} & f'_{c_2} \\ g'_{c_1} & g'_{c_2} - \dfrac{v}{x} \end{vmatrix} = 0 \quad . \quad . \quad ($$

rom which the equation (3) of our note may be educed. (The plus sign in front of the square root f equation (3) of our communication should be eplaced by a minus sign.)

There is a second equation connecting c_1, c_2 in the eveloped band. This is equation (2) of our previous aper and it can be employed to find the level at hich the equation (2) given above begins to hold, hat is, the point where c_2 is zero. Now according o Glückauf, at this point dc_2/dc_1 is discontinuous. t follows from our theory that it is, in general, ontinuous and has the value zero. This we feel s physically more reasonable than the hypohesis of Dr. Glückauf. From this it follows that $g'_{c_2})_{c_1=0} = (f'_{c_1})_{c_2=0}$ and the complete theory as iven in our previous communication.

Under some special conditions and if some f the original undeveloped band is still present, may be possible that $\left(\frac{dc_2}{dc_1}\right)_{c_2=0} > 0$. This would seem o be the case discussed by Dr. Glückauf. However, here are other points in which our theory differs rom his even for this case, and we find ourselves nable to agree with his main conclusions.

A full discussion will be given in our forthcoming ublication.

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J. WEISS.

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See *Nature*, 155, 725 and 156, 205 (1945).

BY changing the sign in front of the square root f their equation (3), Prof. Offord and Dr. Weiss ave made this equation in substance identical with ay proposed equation (1.1), though the complexity f the differential functions tends to hide this fact rom the eye of the reader. As regards the "scarcely lausible" discontinuity at the rear of the mixed and, which is quite plausible to de Vault (1943), have convincing experimental evidence which will e published in due course.

The implied suggestion that the tail end of the ixed band can be influenced by the state of the ront boundary (whether developed, undeveloped r eluted) must be strongly repudiated both on heoretical and experimental grounds. The conitions of the diffuse back boundary depend on the itial concentrations independently of whether these re still present in the chromatogram or not.

A correct general solution must contain the correct olution of any special isotherm. Offord and Weiss's quations (6 and 7) when applied to the Langmuir otherm (using the notation of my earlier letter) ad to

$$V = b_1 m_1/\delta^2 \quad \text{(Offord and Weiss 7, Langm.).}$$

y corresponding equation, obtained by direct interation of the common equation (Offord and Weiss 2 r Glückauf 1) is

$$V = b_1 m_1(1 + \lambda)/\delta^2. \qquad \text{(Glückauf 9).}$$

hus, one of the two theories is wrong.

The apparently slight difference is of the greatest ractical importance. Contrary to equation (Glückauf), equation (Offord and Weiss 7, Langm.) would ean that the volume of developing solvent required r complete separation is independent of the conentration of the solutes in the developing solvent. No practical chromatographer will agree to that, especially for substances difficult to separate. Equation (Offord and Weiss 7, Langm.) would also require that V is independent of the quantity m_2. I have experimental proof that this is not so. Moreover, in the case of comparatively low adsorption intensities, ($b_1 c^0_1 \lll \delta$), the Langmuir isotherm must revert to the ideal case where Wilson's equation, $V = v^0/\delta$, is valid. As shown in my first letter, my equation (9) fulfils this demand, while equation (Offord and Weiss 7, Langm.) does not.

Finally, the laborious though not difficult graphical integration of $df/dc_1 = dg/dc_2$ has been carried out for several types of isotherms, using numerical constants. The results for the Langmuir isotherm are identical with those of my theory. All integrations show that Offord and Weiss's conclusions (reiterated in their second communication) are in complete disagreement with this fundamental equation from which their results are supposed to be derived.

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Determination of β-Carotene in Dried Grass

AT the time when the tentative official method for the estimation of carotene in dried grass[1] was drawn up, it was recognized that it gave results which included one or more pigments other than β-carotene[2,3]. However, at that time there seemed little chance of working out a satisfactory process for β-carotene on account of difficulties in obtaining a suitable adsorbent; and in accordance with the usual custom it was decided to return the whole of the petrol-soluble phase as 'carotene'. Although it has been shown that β-carotene predominates, yet this may account for only 70 per cent or even less of the 'crude carotene'.

Mann[4] has proposed the use of the name neo-β-carotene for the major pigment of the remainder, in deference to Beadle and Zscheile[5], who propose this name instead of pseudo-α-carotene referred to by Carter and Gillam[6].

Mann had pointed out that this second major pigment of grass is not the pseudo-α-carotene of Carter and Gillam, and shortly after, Zechmeister[7] published data on the isomerization of the carotenoids in which he sets forth a method of nomenclature in which pseudo-α-carotene will fall into the category of neo-β-carotenes. Zechmeister shows these neo-β-carotenes to be true isomers of β-carotene entering into *cis-trans* isomerization by heat, by iodine catalysis, by acid catalysis and by the action of light.

Other workers[8,9] have found that such neo-β-carotenes have biological activity; these findings we believe reasonable to adopt in view of the fact that the neo-β-carotenes which they investigated were part of the β-carotene isomerization complex.

To avoid confusion in the literature and to conform to Zechmeister's new nomenclature, which regards neo-β-carotene as the name of a group of isomers, we propose that the previously mentioned other petrol-soluble 'carotene' pigments of dried grass should be termed 'spurious carotenes', and that the use of the name neo-β-carotene for the major component of those pigments should be discontinued. In support of this suggestion, it is to be noted that other workers[2,4,9,10] have encountered such petrol-soluble pigments which have shown negligible or no biological activity.

As both Mann and Zechmeister show that solutions of β-carotene tend to isomerize with heat or standing, and upon isomerization have a lowered molecular extinction coefficient with altered absorption maxima, we would direct the attention of workers to the necessity for the use of as little heat as possible in preparing β-carotene extracts of dried grass, and the further necessity for as rapid estimation as possible of the β-carotene in the solution.

Both of us have suggested the use of chromatographic methods for the separation of β-carotene from all other pigments occurring in dried grass[3,4], and we propose to communicate with other workers interested in this subject in order to promote examination of methods which may produce more concordant results than are obtained at present.

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W. M. Seaber.

Salmon and Seaber,
Oak Avenue, Hampton, Middlesex.

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Preparation of Silicic Acid Jellies for Bacteriological Purposes

For the preparation of jellies intended for the cultivation of micro-organisms, agar-agar is generally used. For some purposes, however, it is desirable to have an opportunity of obtaining cultures of bacteria or fungi on inorganic gels to which only known substances are added. Agar-agar is an organic substance varying in composition and containing other organic substances, which may influence the cultivation of bacteria. Attempts have been made to prepare gels, for example, of silicic acid; sodium silicate and hydrochloric acid were used for the purpose[1,2,3,4]. But this method entails certain difficulties. Instead we have tried to make silica gels for bacteriological purposes from *ortho*-silicic acid tetramethyl ester, $Si(OCH_3)_4$. When water is added to this silico-compound, silicic acid and methanol are formed, and the solution is transformed into a firm coherent gel as clear as glass. This gel formation was observed by Grimaux[5].

The simplest method for the preparation of these gels is to autoclave a mixture of the silico-ester and a suitable nutrient solution in the usual way in a test-tube, in which the gel is formed, the tube being sterilized simultaneously. After the sterilization, the tube must not be cooled too fast as the gel is then apt to crack. The best way of avoiding bubbles and cracks during sterilization of the gel is to employ boiled water or boiled nutrient solution.

During the hydrolysis, however, methanol is formed, which does not completely disappear on aut claving and prevents more delicate bacteria fro growing. In order to enable such bacteria to gro it is necessary to remove the methanol entirely an to this end a more complicated method must b employed. We therefore propose the followin method. 1 ml. $Si(OCH_3)_4$ is mixed with 10–20 m water, when there appears a slight turbidity. Th solution is centrifuged until it becomes clear an then poured into tubes or other suitable vessel The solution becomes a clear gel when the vesse have been left standing at room temperature for son days or are kept warm in an autoclave in the usu way. Water is poured over the gel, and the methan diffuses into the water and is thus removed. Th water is replaced by a suitable nutrient solution which buffer substances may be added to give th gel a suitable *p*H. The tubes must be kept at temperature high enough to prevent the growth bacteria. When the gel has absorbed the nutrie substances for some time, the liquid above the su face of the gel is poured out, the tubes are aut claved in the usual way, and are then ready for us

The silica gels are more apt to dry up than aga agar, so they ought to be kept in moist air, f example, in a closed jar with some water in th bottom.

The gels have been tested by cultivation of *Ba vulgatus*, *Leuconostoc mesenteroides* and *Schizosacchar myces* Pombe, and in all cases the results were pos tive. Investigations concerning the applicability f bacteriological purposes of silicic acid gels from th methyl ester will be continued by Dr. H. Laurell.

We wish to thank Profs. The Svedberg and Ar Tiselius for the provision of laboratory facilities, well as Dr. H. Laurell for advice. The silico-ester w kindly placed at our disposal by the Uddeho Company (Skoghallsverken), Sweden.

Björn Ingelman.
Ingvar Jullander.

Institute of Physical Chemistry,
University of Uppsala.

July 4.

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Enamel Cuticle (Nasmyth's Membrane) and Tartar Deposition in the Ferret

A form of parodontal disease has been previous described, in which the initial lesion of the gum w caused by the impingement and eventual penetrati of salivary calculus[1,2]. Both tartar deposition a gingival disease were prevented by including in t diet short lengths of bone with small amounts muscle, tendon and periosteum left *in situ*. The latt attachments fed separately had no prophylactic i fluence, and their importance lay in their providi the main inducement to gnawing of the bone by t animals. The tartar-preventing action of bon gnawing was largely due to the mechanical friction the hard bone against the tooth surfaces, and its cur tive effect on established parodontal lesions was al demonstrated.

While the precise cause of these calcareous acc tions is still undetermined, a series of recent observ tions has led me to believe that the enamel cutic—

Nasmyth's membrane) plays an important part in tartar formation. First, in the relatively young ferret this cuticle covers the whole part of the tooth exposed to the mouth. As the animal grows older, an increasing amount of the cuticle becomes worn off during mastication, the parts of the teeth first and most affected being those which occlude on biting. The more sheltered areas, such as the upper buccal or lower lingual grooves between the carnassial tooth cusps, remain comparatively free from masticatory friction in the absence of access to dietary bone. Even when pieces of bone (plus attachments) do orm part of the ferret's diet, the cuticle in these ntercuspal grooves may retain much of its original hickness for some considerable time. It follows, then, hat at any given time subsequent to complete erupion and full function of the teeth, the amount of namel cuticle on any given area of a tooth depends not only upon the degree of friction exerted by occlusal and masticating stresses, but also upon the anatomical form of the tooth crown. In the ferret he number of sheltered intercuspal grooves is greatest in the molar and upper fourth premolar and least in the incisor teeth, so that, given the same masticatory friction, the latter lose their enamel cuticle at a proportionately faster rate; the difference is, however, to some extent reduced by the fact hat the carnassial teeth bear the brunt of masticaion, especially when bone is gnawed.

Secondly, as described previously, dental calculus first appears in the upper jaw of the ferret in the groove between the buccal cusps of the fourth premolar adjacent to the opening of the parotid duct, and in the occlusal depressions of the somewhat udimentary first molar near the opening of the infraorbital salivary duct. In the lower jaw, calculus is irst laid down in the lingual groove between the first molar cusps adjacent to the orifice of the retroingual gland; in the ferret the latter takes the place of submaxillary and sublingual glands. In other words, the mouths of the salivary ducts are close to hose particular areas of the denture in which the namel cuticle is relatively persistent and which in urn show the first and heaviest accretions of tartar.

Thirdly, microscopic preparations of teeth and parodontal tissues clearly demonstrate the very firm adherence of the organic constituents of tartar to he enamel cuticle, even after such drastic treatment as decalcification in 2 per cent nitric or hydrochloric acid, dehydration in alcohol and ether, celloidin and/or paraffin impregnation, and sectioning on the microome. The implication is that some association exists between the organic constituents of tartar and enamel uticle. Moreover, there is evidence to indicate that, in ferrets given bone to gnaw, not only are they free from tartar and parodontal disease, but also *in time* he enamel cuticle is itself largely removed by friction and, on subsequent withdrawal of the dietary bone, the teeth still remain free from all but a trace of tartar in the most sheltered grooves distant from the um margin.

Finally, under certain conditions, calcium-containing material is laid down *in vitro* on pieces of enamel uticle, removed by acid from ferret or human teeth, n incubation in human saliva.

It seemed possible that the foregoing findings might be something more than coincidental and, indeed, hat presence of the enamel cuticle might be a prerequisite for the deposition of dental calculus. With the purpose of determining whether or not the cuticle is indispensable to the initial formation of tartar in ferrets, a series of experiments is now in progress in which the teeth of animals fed on bone-free diets are being submitted to various procedures designed to remove or destroy the enamel cuticle.

The results will be reported in due course, but already some evidence has been obtained in support of this new approach to an old problem.

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Nutrition Building,
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[1] King, J. D., *Brit. Dent. J.*, 77, 221, 245 (1944).

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Conditioned Excitors and Human Sense Organs

ABOUT ten years ago, Alexey Bogoslavsky and Krikor Kekcheyev in Moscow and Alexander Dolin in Leningrad, working independently, demonstrated experimentally that the sensitivity of the human sense organs may be considerably modified under the influence of an indifferent factor, for example, the weak beat of a metronome, if it is accompanied several times by the influence of an active excitor. It was found that the latter, acting on an appropriate sense organ (for example, a sweet substance on the taste organ, or an odorous substance on the sense of smell), simultaneously changed the sensitivity of the entire sensory sphere of the brain. As in other conditioned reflexes, already studied, in which the excited organs were the salivary glands or definite groups of muscles, so in the case of our sensory conditioned reflexes, one rule must be observed: the formerly indifferent, or, as Pavlov called it, the conditioned excitor must be 'reinforced' several days in succession by the action of an excitor which by itself always produces the desired effect (unconditioned excitor).

The Institute of Psychology in Moscow has in recent months conducted a series of experiments in which the conditioned excitor was not a physical agent, but a phrase or sentence, the meaning of which bore no relation to the experiment itself. A passage is read aloud to the subject and when a given phrase is reached his face is rubbed with a cold wet towel. This was done several days in succession, after which measurements of the sensitivity of the eye, or more exactly, of its powers of night vision, revealed a marked enhancement of sensitivity after the phrase constituting the 'conditioned excitor'—and only after that particular phrase—had been read (Dubinskaya). This demonstrated that conditioned sensory reflexes may be formed not only by physical or chemical excitors (Pavlov's first signal system), but also by words and sequences of words (Pavlov's secondary signal system).

In another series of experiments, which is inherently connected with the one just described, the sensitivity of sight and hearing was modified not by the influence of physical excitors themselves (light, sound, cold, mechanical action, etc.), but only by the idea of the corresponding sensations. The changes in one direction or the other were well marked and lasted for about half an hour. The idea of the bright light of automobile headlights invariably enhanced sensitivity of hearing (this effect was also produced by the direct action of light on the eye), and the idea of the noise of a motor, just as the noise itself, always resulted in a marked diminution of sensitivity of night vision. Similar effects are produced by the ideas of sweet and bitter. The idea of the sensation always produced a change, and invariably in the direction which would have resulted from the action of the excitor itself. Emotionally pleasant ideas invariably enhanced the sensitivity of all the sense organs. The idea of weak excitors produced the same effect as the weak excitors themselves. The opposite effect was produced by the idea of strong excitors, for example, of very sour substances or of uncomfortably hot water.

It has been demonstrated in my laboratory that sensitivity to red light increases after action on the eye of its complement green light, and vice versa, although in a lesser degree. This is likewise true of yellow light and its complement, blue light (Schwarz). We now find that the idea of red or yellow light increases the sensitivity of the eye to its complement (green or yellow light), but that the idea of the latter does not have the same effect.

The researches here briefly described transcend the bounds of physiological optics and are of great value for our understanding and quantitative evaluation of certain aspects of the influence of the mind on the physical state in man, and, in particular, on the functional state of the sense organs.

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Demonstration of Mitosis in Animal Cells

In a recent communication, Lloyd[1] raises the subject of the teaching of mitosis to zoology students. The materials which he recommends are the developing eggs of various species of nematode worms, and his method is a smear technique.

Slides of maturing and cleaving nematode eggs are also used extensively in the United States and in Canada for teaching mitosis to zoology students; and indeed nowadays it is probably correct to say that the practice is general, except in so far as it has been superseded by the use of slides of cleaving teleost eggs. The nematode used is *Ascaris equorum* Goeze (*A. megalocephala* Cloquet), the horse-worm, which is always readily available and has the advantage of possessing only a small number of chromosomes. The slides are prepared not by a smear technique, which might prove to be considerably easier, but by sectioning the uterus after the fixation of that organ, or of the whole worm, by one of the drastic methods normal for nematodes. Before embedding, the uterus is sometimes bent backwards and forwards upon itself so that each final slide contains numerous sections from several different levels and shows many different stages of mitosis. For a zoologist, these sections of *Ascaris* are in every way superior to those of root tips, and they are as suitable for first-year classes as for advanced students.

However, as an alternative which is considered by some to be even better, whitefish eggs in early stages of cleavage are now being used increasingly (whitefish is a salmonid species, *Coregonus clupeiformis* Mitchill, common in the Great Lakes). Although these eggs are not so readily available, they are easy to prepare in that fixation is simple and sectioning is unnecessary; slides are being marketed in increasing numbers by the large American biologic supply houses which had previously concentrate almost exclusively on the eggs of *Ascaris*.

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July 4.

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[1] Lloyd, Ll., *Nature*, 155, 636 (1945).

Late Flowering of Horse-Chestnut

While passing through Paris recently en route t and from Switzerland, I noticed that a number o horse-chestnuts in the streets were still in flower—quite a number on September 11, and a few sti on October 4.

On these dates, perhaps a third of the trees showe foliage normal for the time of year. On the remainde all or most of the leaves were already withered an brown. I understand that this was due to a sever frost, followed by very dry weather in the sprin Of these prematurely withered trees, a considerab proportion showed a few branches or shoots wit normal leaves—indeed, greener than those on th trees which had not been damaged by the frost and a fair number of these green shoots carrie flowers. The same phenomenon, but to a less extent, was noted among horse-chestnut trees i western Switzerland in late September.

It would seem that the premature damage to th foliage had stimulated the production of new shoot from buds that would normally have developed nex spring, some of which managed to flower as well as t produce new leaves. The phenomenon would thu appear to be very similar to the new growth of leave and sometimes of flowers observed in various tree in London after being wholly or largely defoliate by bomb-blast[1]. However, the lateness of blosso must, I think, be exceptional.

Julian Huxley.

16 Queen Anne's Gate,
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Oct. 9.

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[1] *Daily Sketch*, Aug. 16, 1944.

Lantern Slides of Line Drawings

The following simple method of making lanter slides of line drawings may be of interest. Whe the diagrams are not already available in printe form, they are drawn in white chalk on a blackboar and photographed directly. The photographic nega tive so obtained is mounted and bound as a lante slide, the resulting projection on a screen being black line drawing on a white background.

As compared with the more usual method of dra ing the diagram in Indian ink, photographing it, ar finally printing the slide from the negative, the savi in time and materials is considerable.

In order to produce the best results by our metho the blackboard should be well cleaned, a chisel-en cut on the chalk, and the negative should be slight under-exposed to minimize traces of backgroun We have found the method suitable for reproduci diagrams of apparatus and mathematical formul It should be equally suitable for biological drawing

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University College,
Nottingham.

U.S. NATIONAL ACADEMY OF SCIENCES

ELECTIONS AND MEDAL AWARDS

Elections to Membership:

Alfred Blalock, professor of surgery, Johns Hopkins edical School, Baltimore, Maryland.

Vice-Admiral Edward Lull Cochrane, Bureau of hips, Navy Department, Washington, D.C.

Henry Eyring, professor of physical chemistry, rinceton University, Princeton, New Jersey.

Enrico Fermi, professor of physics, Columbia niversity, New York.

James L. Gamble, professor of physiology, Harvard edical School, Boston, Massachusetts.

Henry Gilman, professor of chemistry, Iowa State ollege, Ames, Iowa.

Beno Gutenberg, professor of geophysics and eteorology, California Institute of Technology, asadena, California.

Harold Hibbert, New Haven, Connecticut (deeased).

Mervin J. Kelly, research physicist, Bell Telephone aboratories, New York.

Victor K. LaMer, professor of chemistry, Columbia niversity, New York.

George W. Lewis, National Advisory Committee r Aeronautics, Washington, D.C.

Ralph Linton, professor of anthropology, Columbia niversity, New York.

Clarence Cook Little, geneticist, director of the oscoe B. Jackson Memorial Laboratory, Bar Harbor, aine.

Paul C. Mangelsdorf, professor of botany, Harvard niversity, Cambridge, Massachusetts.

John Howard Mueller, professor of bacteriology nd immunology, Harvard Medical School, Boston, assachusetts.

John R. Paul, professor of preventive medicine, ale University Medical School, New Haven, Conecticut.

John B. Reeside, U.S. Geological Survey, Washgton, D.C.

Francis W. Reichelderfer, United States Weather ureau, Washington, D.C.

William W. Rubey, U.S. Geological Survey, Washgton, D.C.

Homer W. Smith, director of the Physiological aboratory, New York University College of Medicine, ew York.

William C. Stadie, professor of medicine, School of edicine, University of Pennsylvania, Philadelphia, ennsylvania.

Otto Stern, research professor in the Physics Deartment, Carnegie Institute of Technology, Pittsurgh, Pennsylvania.

Harald U. Sverdrup, director of the Scripps stitution of Oceanography, La Jolla, California.

Cornelis B. van Niel, professor of microbiology, opkins Marine Station (Stanford University), acific Grove, California.

John C. Walker, professor of plant pathology, niversity of Wisconsin, Madison, Wisconsin.

Alexander Wetmore, ornithologist, secretary of the mithsonian Institution, Washington, D.C.

Hassler Whitney, associate professor of matheatics, Harvard University, Cambridge, Massachutts.

Eugene P. Wigner, Thomas D. Jones professor of physics, Princeton University, Princeton, New Jersey.

Robert R. Williams, chemical director, Bell Telephone Laboratories, New York.

Benjamin H. Willier, professor of biology, Johns Hopkins University, Baltimore, Maryland.

Foreign Associates:

Sir Lawrence Bragg, Cavendish professor of experimental physics, University of Cambridge.

Dr. Harold Jeffreys, reader in geophysics, University of Cambridge.

Paul Karrer, professor of experimental chemistry, University of Zurich.

Prof. The Svedberg, professor of physical chemistry, University of Uppsala.

Sir Geoffrey Taylor, Yarrow research professor of the Royal Society.

Medal Awards:

Henry Draper Medal for 1945 to Paul W. Merrill, astronomer, Mt. Wilson Observatory (Carnegie Institution), Pasadena, California, for his many important contributions to astronomical physics, in particular those relating to his researches in stellar spectroscopy.

J. Lawrence Smith Medal (No. 3) to Stuart H. Perry, Adrian, Michigan, for his original investigations of meteoric bodies.

Marcellus Hartley (Public Welfare) Medal to Vannevar Bush in recognition of his outstanding service in bringing to bear the scientific and engineering talent of the United States upon problems of research connected with the war effort.

Daniel Giraud Elliot Medals:

1941. Th. Dobzhansky, for "Genetics and the Origin of Species" (second edition).

1942. Sir D'Arcy Thompson (The University, St. Andrews, Scotland), for "On Growth and Form" (revised and enlarged, 1942).

1943. Karl Spencer Lashley, for "Studies of Cerebral Function in Learning" (*J. Comp. Neurol.*, **79**, 431; 1943).

Mary Clark Thompson Medal to Thomas Wayland Vaughan, in recognition of his outstanding achievement in his ingenious co-ordination of observations and generalizations made in, and bearing on, the fields of stratigraphic geology and palæontology.

The fifth John J. Carty Medal and Award was presented to William Frederick Durand, "in his profession a versatile and creative Engineer; among his colleagues a wise and friendly Counselor; before his students a kindly and inspiring Teacher; to the Nation an able and devoted Servant".

Awards to the National Academy of Sciences and National Research Council:

The American Pharmaceutical Manufacturers' Association Award of Distinction was presented to the National Research Council in recognition of its fundamental contributions to public health in the field of the medical sciences and also in recognition of its essential services to the United States during the First and Second World Wars.

Lord and Taylor Annual American Design Award for 1945 to the National Academy of Sciences in recognition of the outstanding achievements of the men of science in the prosecution of the War and for the furtherance of research for national security.

RECENT INVESTIGATIONS ON THE GROWTH OF BONE

By PROF. P. LACROIX
Institute of Anatomy, University of Louvain

ANY condition in which bone grows or disappears seems bound to involve some of the mechanisms of normal bone growth. Therefore it was felt that, in the long run, the best way to approach some of the problems of surgical bone pathology would be to deal first with normal development, and to submit the whole question to a new inquiry in the light of recent embryological advances.

The first results of this study are now being published[1] and will be briefly summarized here.

(1) In rabbits, the distal growth cartilage of the radius and the growth cartilage of the rib were cut off by two transverse and parallel sections. Their peripheral region was then entirely taken away by four sections at right angles. The disk-shaped growth zone was thus reduced to a small cube consisting exclusively of cartilaginous tissue without any remnant of the ossification groove (Ranvier's "encoche d'ossification"). This piece was grafted into the brain or under the kidney capsule or into the medullary cavity of the tibia in other rabbits. When recovered, it was found to have produced a large quantity of endochondral trabeculæ which were being resorbed and replaced by hæmopoietic marrow. All around the cartilage, cells which seemed to be ordinary fibroblasts had gathered. Some of these cells had taken part in the formation of a thin bony lamella surrounding and flanking the growing cartilage. The formation of this bony ring is a typical example of an induction phenomenon.

Now this observation led to the reconsideration of the structure of the growing long bones, and it was found—however surprising it may seem that such an obvious detail could have been overlooked thus far—that the ossification groove contains a perichondrial ring identical with that of the grafting experiments. The formation of this ring was traced back as follows : in its earliest stage the diaphysis is a continuous bony tube, but after a while its extremity is cut off from the rest of the bone by osteoclasts and becomes the perichondrial ring of the ossification groove ; this change of structure is brought about by the endochondrial tabeculæ beginning to take part in the constitution of the diaphyseal extremities.

From these facts it was inferred that the formation of the normal perichondrial ring and of the earliest form of the diaphysis is the result of inductive activity depending directly or indirectly on the growing cartilage.

(2) Yet another instance of an induction phenomenon in bone growth is provided by the following experiments. A rod of hyaline cartilage was taken from the rib of a rabbit and put into the upper extremity of the tibia of another young rabbit in such a manner that it pierced the centre of its proximal growth cartilage. The latter, in spite of its having been wounded, went on proliferating and a close contact was established between the grafted cartilage and the growth cartilage. After a few weeks the grafted cartilage was the seat of a typical endochondrial ossification. Since the serial sections proved that no cells of the host cartilage had invaded the graft, the phenomenon was to be considered as one of assimilatory induction.

(3) The two previous groups of experiments a clear-cut evidence of the part played by inductio at a much later stage than one would ever hav thought. They point strongly toward the existenc in the growing cartilage of an organizer. The questio has been pushed another step forward by the following crucial experiments.

An alcoholic extract has been prepared from th cartilaginous epiphyses of the long bones of newl born rabbits and injected into the thigh muscles other rabbits. Forty-one days afterwards, a larg osteoma was found in the thigh. Its histologic examination revealed the presence of all the structur which may be analysed in a growing long bone growth cartilage with its characteristic row arrang ment and partially surrounded by a perichondri ring of the ossification groove, circular or triangul diaphysis enveloped by a periosteum and containin a functional hæmopoietic marrow.

Thus not only the endochondrial ossification bu even the organization of the diaphysis seem to b under the influence of a substance or a group o substances which I suggest calling *osteogenin*.

According to the view put forward at the beginnin of this article, evidence should now be sough of the intervention of such a factor in variou pathological and surgical conditions (periosteal an medullary osteogenesis, formation of a fracture callu evolution of a bone graft, etc.). Further research wi then have to show whether the possibility of promoting osteogenesis at will is really within easy reach.

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[1] *Mém. Acad. Roy. Méd. Belg.*, 2, Fasc. 2 (1943). *Acta biol. belg.*, 3, 9 (1943). *ibid.*, 3, 124 (1943). *ibid.*, 3, 125 (1943). *ibid.*, 25 ma 1944 (in the press). *Arch. Biol.*, 56, 185 (1945). *Anat. Rec.*, 194 (in the press). *Arch. Biol.* Fasc. 3, 1945 (in the press).

SCIENTIFIC AFFAIRS IN EUROPE

FROM time to time news is being received o scientific men and institutions on the Continen of Europe, who have been cut off from Great Britai for some five years. A note referring to some Belgia biologists and Belgian biological publications, base on material provided by Dr. Julian Huxley, appeare in *Nature* of August 11, p. 166. Dr. John W. Well contributed an article on French and German geographical and geological institutes to *Nature* August 25, p. 243. Dr. F. W. Sansome has referre to correspondence with some Danish men of scienc (*Nature*, September 1, p. 263). Now Dr. Huxley ha put at our disposal two letters received by him fro Dr. N. Tinbergen, of Leyden, and Dr. A. Buzzat Traverso, of Verbania, Pallanza, Italy, the substanc of which is printed below.

Throughout all these communications, the intens desire to re-open relations with scientific men i Great Britain is apparent, and it is to be hoped th British men of science will, as soon as condition permit, get into touch with correspondents in th liberated countries and exchange reprints with then in the interests of international relations.

From Dr. Tinbergen :

The situation in the Netherlands is still more less chaotic. We have great admiration for the sw and efficient help by the 'food flying squads' th have brought immediate relief to our people at a instant when thousands were dying of starvatio We owe an enormous debt of gratitude to the inst gators and organizers of that huge enterprise. Re unger is over now, but the after-effect, bodily and moral and spiritual, of the German terror and hunger ombined is still evident. . . .

Scientific work, which was little affected in the rst year of occupation, has practically come to a andstill in the last year. In 1942 we had a great ash with the Germans, who wanted to nazify the niversity of Leyden; we did not 'surrender' and ook our leave; as a reprisal we were put into an nternment camp as hostages, and spent two years here. They did not shoot us, however, and all but ne of us have safely returned. That one was Prof. 'elders, who died in a German concentration camp. n Utrecht, Jordan has died.

I want to renew and intensify the contact and o-operation with British students of behaviour, and am sure most of my Dutch colleagues in the field of nimal psychology are of the same opinion: we all ave a great longing for international interchange of leas. I do not intend to cut off all relations with erman scientific men. But first I must not see them or a long time, so as to overcome the psychological version resulting from the incredible German terror ve underwent; and secondly I want only to renew ontact, eventually, with those investigators that personally know as honest and reliable men, such s Rensch, von Frisch, Stresemann, Lorenz and I hope) Laven.

As soon as it is permitted, I will send you the ublications that have appeared in my department etween 1939 and 1942, the year of the clash with he Germans, when I stopped all publishing. The ther universities did not have such a formal clash, hough all of them were languishing. Much of my wn recent work has been centred on "das angeborene uslosende Schema" ('releasing mechanism'); field vork on *Satyrus semele*, published in *Z. f. Tierpsychologie*; laboratory work with the three-spined stickleback, an excellent object (most of this work still unpublished); laboratory work with a number of ichlid fishes (unpublished); and field work with he herring gull (only short papers on fragments f the work). Continuation of this last piece of vork will be impossible for some years, to my great egret, as the dunes are 'peppered' with land nines.

Bierens de Haan, after nearly dying of starvation, s all right again; he has written a voluminous book n instincts, and now is writing one on the psychology f the dog. Portielje is all right, and active as ever. Ie wrote an interesting study of the orang-utan. 'erwey had to leave his laboratory in Den Helder, hich in the course of the War was absolutely robbed y the Germans; he was fifteen months among us as a ostage in the same internment camp, as also were rof. Van der Klaauw, and Koningsberger, the trecht botanist, successor of Went. A new star in he sky of animal psychology is A. Kortlandt, a oung fellow, very clever, very original, very 'cormorant-minded'; for years he has lived among the ekkerkerk cormorants, day and night, most of the me in a hide in the nest-trees, where he often tayed for one or more weeks, day and night continuously, receiving his food by a 'téléférique' *Drahtseilbahn*).

Kluyver, the starling man, is all right; he had to ave Wageningen in September 1944, and his house as badly damaged, but he managed to save all the otes of his extensive study on the great tit, and ost of his books, and has recently returned. The overnment Phytopathological Service, where Kluyver was the ornithologist, has been absolutely ruined by the Germans. All records and files have been burned, as well as the library, one of the many instances of the enormous setback caused by the War. Sirks, Hazelhoff, Dijkgraaf (nephew and pupil of Von Frisch), Raven, Krijgsman, my brother L. Tinbergen, Ihle, De Beaufort are all right. Ihle very nearly died of starvation. Owing to the very limited possibilities of travelling and writing (no trains; cycling only possible during some hours of the night, to avoid the German slave-hunters), we heard such things mostly too late to help each other. De Burlet, much to our regret, has been co-operating with the Germans. He has fled and nobody knows where he is. Hirsch, who was a German, seems to be in Germany.

You may wonder whether we will have time to resume 'pure' scientific research, now that all kinds of reconstruction work will demand so much of our energy. I am sure that we will succeed in keeping part of our time for research.

From Dr. Buzzati-Traverso:

It has been possible for myself and some of my students to carry out a good deal of work (largely published in Italy) on the population genetics of various European species of *Drosophila*, and on induced chromosome mutations. The work was planned jointly with Timoféeff-Ressovsky, in whose Institute in Berlin I worked for five months in 1942. (The last news I had of Timoféeff-Ressovsky was from Hans Bauer in November 1944, to say that he was still working in Berlin. Bauer was then working near Tübingen, where the whole Kaiser Wilhelm Institut für Biologie had been transferred, after being slightly damaged in the early bombing of Berlin.) In Italy the work was done at the University of Pavia. As soon as possible after the Italian armistice, I transported everything I could from Pavia to the Istituto Italiano di Idrobiologia at Pallanza, and thus was saved from destruction a collection of more than two hundred stock cultures of *Drosophila*. This, I believe, is the only collection of *Drosophila* stocks surviving in continental Europe outside the U.S.S.R.

The Istituto Italiano di Idrobiologia was founded in 1939. It is a private foundation with two main laboratories, the principal at Pallanza, the other at Varenna on Lake Como. This is a research institute devoted to the study of problems of lake biology and of limnology. The director, Prof. Edgardo Baldi, is interested in problems of freshwater biology which are of significance for more general biological questions; the Institute is largely concerned with problems of the biology of the animals of freshwater basins. During the last couple of years, a number of such questions have been investigated from the point of view of population genetics.

My stay here has shown me that the combination of field work and study with genetics is likely to be fruitful. Accordingly, Dr. Baldi and I have decided to set up a genetics department of the Institute, under my supervision. We have a number of able young men available for work in this field, including Dr. L. Carvalli, a brilliant worker in statistical genetics and biometry. Our financial prospects appear bright.

In 1943, Prof. Baldi organized a symposium, in which about a dozen biologists, palæontologists and geologists took part, on micro-evolution during the Pleistocene. We have also worked out plans for co-operative work in the mountains above Trieste and in the region of Monte Circeo between Rome and

Naples, though the political and military position has so far not permitted their realization.

Italian biology was not good even before the War, and has since become worse owing to the destruction of many university laboratories and libraries. We feel that there is not much to hope for immediately from the academic milieu, because on one hand the new Italian Government is facing much more urgent problems than university re-organization, and on the other hand many professors of biology are wholly out of sympathy with modern ideas in this subject, and unlikely to be removed from their posts. Accordingly, we believe that the only way to improve the level of biological research and to raise a new generation of modern-minded biologists is to have institutes outside the universities which, keeping the closest possible contacts with foreign laboratories, should introduce the methods and the approach which I have had the good fortune to know and to appreciate in the United States, in Britain, and in some German laboratories. We think that for the time being such extra-university institutes might be the Istituto di Idrobiologia, the Stazione Zoologica in Naples, and perhaps the Istituto do Sanità Pubblica in Rome, which includes well-known physicists, such as Edoardo Amandi, who are very much interested in biophysical problems.

The most urgent need for us now is to become acquainted with the scientific production of the Allied Nations during the last five years. We need books and journals concerning genetic, ecological and general biological problems, to make our existing library comprehensive and up to date.

I suppose that in connexion with any new international organization, some kind of committee for international scientific co-operation is likely to be set up.

Dr. Huxley has also added the following postscript containing further information which he has obtained while in Switzerland and France during September.

(1) *German Ornithology*. While in Switzerland, I was given a copy of a letter written on August 1 by Dr. Erwin Stresemann of Berlin, the leading continental ornithologist, to a Swiss colleague:

> The centre of the city has been almost completely destroyed and has become a ghastly heap of rubble. Our museum, however, has not been too badly damaged and we have been doing repair work for some weeks, with a view to opening the collection to the public. Two rooms of the bird department were very badly damaged during an air raid on March 18, 1945, thus unfortunately destroying almost the entire scientific collection of stuffed birds of 1810–88, as it had not been possible to move these from their cases owing to lack of space and means of transport—for there are (or were) 25,000 specimens! I was, however, able to evacuate most of the types to safety, as well as the modern collection of skins and all the books. I have for some time been engaged in bringing these back to their old home and arranging the bird department as it used to be. I am being helped in this work by Mr. Hermann Grote, who has been appointed as my assistant. The important library of the Deutsche Ornithologische Gesellschaft and the stock of unsold journals (*J. Ornithologie, Ornith. Monatsberichte*, etc.) have also been saved.
>
> As we in Berlin are cut off from the world, I still know little about the fate of ornithologists in other parts of Germany. Dr. Oskar Heinroth died of pneumonia on May 31, 1945, consequent upon mar nights spent in an air-raid shelter during the heav raids of March and April—an irreplaceable loss. news of Schuster. Dr. Otto Schnurre visited me short time ago: he is now *kommisarischer* direct of the Berlin City Library. Dr. E. Schütz wro from Danzig last March, when that town was e circled and being attacked by the Russians—wh may his fate have been? Dr. F. Tischler has r mained in East Prussia. There is no news at all the numerous Silesian ornithologists. The bi observatories of Heligoland and Rossitten are pro ably things of the past—for all time. I cannot the present moment say whether I shall ever able to re-start the *J. Ornithologie* and the *Ornit Monatsberichte*; for the time being their resumpti is unthinkable.
>
> That great pioneer in animal psychology, Pro Konrad Lorenz, was last summer reported missi near Vitebsk, probably killed; he was working as doctor in a front-line hospital.
>
> I expect that professional circles abroad will interested to hear how the War and the collapse Germany have affected German ornithology. I da not think that it has disappeared for ever, and long as I am able to do so I will devote all my energi to it, so that it may, at some future time, rise phœni like from its ashes. . . .
>
> P.S.—The ringing records of the bird observatory Rossitten were removed to Central Germany in tim and I expect that they are safe and can be use again in the future.

It may be recalled that Dr. Stresemann gave acti help and encouragement during the War to tw young British prisoner-of-war ornithologists, wh organized groups in their prison camps to study th detailed behaviour of certain bird species. We ma shortly expect the publication of their valuab data, obtained in circumstances that must unprecedented.

(2) *German Genetics*. Through Prof. Boris Ephrus of Paris I heard the welcome news that Dr. Timoféef Ressovsky, the eminent Berlin geneticist of Russia origin, has made satisfactory arrangements with th Russian authorities to continue his work in th U.S.S.R., and has already left Berlin with most the staff and equipment of his Institute.

(3) *General Biology in Germany*. Inquiries i zoological circles in Switzerland elicited the followi facts concerning German and Austrian biologists.

Hans Baur (Berlin), M. Henze (previously Innsbruck), E. Rotmann (Cologne Vogt) an probably A. Kühn are alive. Von Buddenbrock, th well-known comparative physiologist, was demote (*strafversetzt*) from Halle to Vienna in 1942 becau of his general opposition to Nazi ideas, and wa thence evacuated by the Americans with many oth men of science to the American zone in German where (in late August of this year) he was in gra financial straits and was not allowed to receive send correspondence to foreign countries. The thi volume of his great book on comparative physiolog dealing with hormones, is now in slip proof, and has begun writing the fourth volume. As it is pro ably impossible for him to return to Vienna, it wou seem highly desirable for this eminent and non-Na man of science to be given a post, in Germany elsewhere, as soon as possible.

A. Penners of Vienna was very badly treated the Nazis, and was probably dismissed from his pos

He attempted unsuccessfully to go to Switzerland before the outbreak of the War. His present whereabouts are uncertain. Ries, Wettstein and probably Seidel are dead. K. Henke and E. v. Holst (Göttingen), Paula Hertwig (Berlin), Hans Nachtsheim and Otto Warburg (Berlin-Dahlem) appear to have been alive at the end of the War, but no news of them has since been received. J. Haemmerling moved from Berlin-Dahlem to the Institut für Seenforschung on the Lake of Constance, but nothing has recently been heard from him.

(4) *Hungary and Czechoslovakia.* I have just heard through the Red Cross that Dr. Alexander Wolsky, he zoologist at the Biological Research Station at Tihany, is alive and well (and also his family) and hat the Research Station is undamaged.

I have also heard that Prof. Jan Belehradek, one-ime professor of zoology and later rector of the Karlovy University of Prague, is well, though he was imprisoned in a concentration camp for a considerable period.

Those who knew Dr. Wolsky and Prof. Belehradek when they were doing research in London in the '30's will be especially glad to hear this good news of hem.

RESEARCH IN THE U.S.S.R. ON THE PHYSIOLOGY OF VISION

THE physiology of vision has always held a peculiar fascination for the physiological theorist, but recently the urgency of immediate practical problems, brought to a focus by the War, has led to a enewed and more direct approach both in this country and abroad. Recent Russian work in this field is published in *Problemy Physiologitchesky Optiky*, 2 (Moscow, 1944), which contains sixteen papers from eleven different laboratories. The papers are in Russian, but a generous English abstract of each is given.

Dealing first with work of immediate practical application, V. G. Samsonova has studied the influence of size of image, central brightness, ratio of central to peripheral brightness on the visual discrimination ime, and has constructed nomograms from which optimum conditions of lighting for factories, etc., can be computed. O. P. Kholmskaya has measured he visibility of traffic lights against a black screen of varying size. The minimum size of screen for optimum visibility is one which subtends an angle of 12′; when the subtended angle is less than 3′ visibility is worse than with no screen at all. C. I. Krol finds that with several stimuli in the visual field and the total area of stimulation kept constant, the ensitivity of the eye varies inversely as the number of stimuli. S. V. Kravkov records changes in visual acuity resulting from auditory stimulation, and O. A. Dobriakova finds that various extraneous stimuli increase the critical frequency for flicker at the red end of the spectrum and decrease it at the blue end; here is a peak of increase in the orange-red and of decrease in the blue-green and an intermediate neutral zone in the yellow.

Turning to more fundamental researches, N. I. Pinegin has made a detailed quantitative study of he absolute sensitivity of the eye in the ultra-violet; at 365μ the eye is 11,000 times less sensitive than at 546μ, and the lower limit of vision is 302μ (Goodeve, Lythgoe and Schneider recently placed the lower limit at 309μ). Evidence is provided that the effects were due to direct retinal stimulation at this wavelength and were not the result of fluorescence in the eye media. M. N. Livanov has studied action potentials in the visual cortex and lateral geniculate body with the electroencephalograph. P. I. Spielberg has recorded action currents from the human eye by means of special electrodes applied to the eyeball; the method is fairly simple and may prove useful in ophthalmic practice. A. I. Bogoslovsky has investigated the response of the human eye to electrical excitation. Bogoslovsky has also found that in dark adaptation, while the excitability of the retina increases, that of the visual cortex decreases and the two seem to be reciprocally related.

When a coloured object is viewed at increasing distances, a point is reached (when the subtended angle is 10–20′) at which the colour changes in a characteristic fashion. B. N. Kompaneisky has studied these colour changes and concludes that the results can best be interpreted on a classical trichromatic theory of colour vision. The method also provides a sensitive test of colour vision; there are some variations even among normal individuals, and colour defectives are readily identified.

FORTHCOMING EVENTS

(*Meeting marked with an asterisk * is open to the public*)

THE DISCOVERY OF X-RAYS

50TH ANNIVERSARY COMMEMORATION PROGRAMME

Medical Meeting

Saturday, November 10

At the Institution of Electrical Engineers, at 2 p.m.

Scientific Meeting

Saturday, November 10

At the Royal Institution, at 10 a.m.

Historical Reviews

Saturday, November 10

At the Institution of Electrical Engineers, at 3.30 p.m.

Saturday, November 10

BIOCHEMICAL SOCIETY (at the London School of Hygiene, Keppel Street, London, W.C.1), at 11.30 a.m.—Discussion on "The Chemical Basis of Cell Structure and Function" (to be opened by Dr. J. F. Danielli and others)

IRON AND STEEL INSTITUTE (joint meeting with the SCOTTISH BRANCH OF THE INSTITUTE OF BRITISH FOUNDRYMEN) (at the Royal Technical College, George Street, Glasgow), at 3 p.m.—Mr. Basil Gray: "The German Steel Foundry Industry".

Monday, November 12

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, South Kensington, London, S.W.7), at 5.30 p.m.—Prof. H. W. Ahlmann: "Summary of Glaciological Researches, 1918–1940".

Tuesday, November 13

CHADWICK PUBLIC LECTURE (at the Royal Sanitary Institute, 90 Buckingham Palace Road, London, S.W.1), at 2.30 p.m.—Mr. F. C. Vokes: "The Modern System of Sewage Disposal and the Methods and Materials Employed" (Bossom Gift Lecture)*.

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Dr. A. Müller: "50th Anniversary of the Discovery of X-Rays", (ii) "After the Discovery of X-Rays".

ROYAL SOCIETY OF MEDICINE (at 1 Wimpole Street, London, W.1), at 5.30 p.m.—Discussion on "Forward Psychiatry in the Army" (to be opened by Lieut.-Colonel H. A. Palmer, Major C. Kenton, Lieut.-Colonel H. B. Craigie and Lieut.-Colonel T. F. Main).

BRITISH ASSOCIATION OF CHEMISTS, NORTHERN SECTION (in the Chemistry Lecture Theatre, King's College, Newcastle-upon-Tyne), at 7 p.m.—Mr. R. Booth: "The Development and Properties of Safety Glass".

Wednesday, November 14

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. A. C. Hartley: "Operation PLUTO".

INSTITUTE OF PETROLEUM (at 26 Portland Place, London, W.1), at 5.30 p.m.—Flight-Lieut. E. Mikolajewski: "Investigation of Piston Ring Sticking in High Duty Aero Engines".

INSTITUTION OF ELECTRICAL ENGINEERS, TRANSMISSION SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. W. J. Nicholls: "Recent Progress in the Design of the High-Voltage Overhead Lines of the British Grid System".

BRITISH INSTITUTION OF RADIO ENGINEERS (at the Neville Hall, Westgate Road, Newcastle-upon-Tyne), at 6 p.m.—Mr. S. G. Button: "U.H.F. Aerial Systems".

British Institution of Radio Engineers (at the Institution of Structural Engineers, 11 Upper Belgrave Street, London, S.W.1), at 6.15 p m.—Discussion on the Radio Industry Council Report on "Post-War European Broadcasting" (to be opened by Mr. R G. Clark).

Thursday, November 15

London Mathematical Society (at the Royal Astronomical Society, Burlington House, Piccadilly, London, W 1), at 3 p.m.—Annual General Meeting. Prof. L. J. Mordell, F R S.. "Thoughts on Number-Theory" (Presidential Address).

Chemical Society (in the Muspratt Lecture Theatre, The University, Liverpool), at 4 p.m.—Mr R. P. Bell, F.R.S : "The Structure of the Boron Hydrides and Related Compounds".

Royal Institution (at 21 Albemarle Street, London, W 1), at 5 15 p.m.—Prof. James Gray, F.R.S.: "The Anatomy and Functions of the Brain in Lower Vertebrates", (iii). "Birds".

Institution of Electrical Engineers (at Savoy Place, Victoria Embankment, London, W C 2), at 5.30 p.m.—Mr R. Davis · "High-Voltage Research at the National Physical Laboratory" (Parsons Memorial Lecture).

Royal Society of Tropical Medicine and Hygiene (in the Bacteriological Laboratory of the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1), at 8 p m.—Laboratory Meeting.

Friday, November 16

Royal Institution (at 21 Albemarle Street, London, W 1), at 5.15 p m.—Dr. A. O. Rankine, F.R.S.: "The Dispersal of Fog on Airfields".

Chemical Society (joint meeting with the **University Chemical Society**) (in the Chemistry Lecture Theatre, The University, Sheffield), at 5 30 p.m.—Prof. I M Heilbron, F.R S . "Our War Against Insect Pests".

Institution of Mechanical Engineers (at Storey's Gate, St. James's Park, London, S.W 1), at 5 30 p m —Sir Edward Appleton, K C.B., F.R S.. "The Scientist in War Time" (Thirty-second Thomas Hawksley Lecture)

Chemical Society (in the Chemistry Lecture Theatre, The University, Manchester), at 6 p m.—Original Papers.

Royal Institute of Chemistry (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 6 p m —Mr. W. Gordon Carey: "Water and Public Health" (Twenty-eighth Streatfeild Memorial Lecture).

British Institution of Radio Engineers (in the Physics Lecture Theatre, University College, Southampton), at 6.15 p.m —Dr Hilary Moss: "Engineering Methods in the Design of the Cathode Ray Tube".

Society of Chemical Industry, Plastics Group (joint meeting of the **Birmingham and Midlands Sections** of the **Society** and the **Royal Institute of Chemistry**) (in the English Theatre, The University, Edmund Street, Birmingham), at 6.30 p.m —Dr. J. C. Swallow: "Polythene".

Chemical Society (at the Royal Technical College, Glasgow), at 7.15 p.m.—Prof J. M. Gulland, F.R.S : "Polynucleotides and Nucleoproteins".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned·

Laboratory Steward for Chemistry, a **Laboratory Steward for Physics**, and **Laboratory Assistants**—The Principal, Acton Technical College, High Street, Acton, London, W.3 (November 14).

Routine Chemist for Trinidad, British West Indies, by a firm producing and refining petroleum products—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W C.2, quoting F.5055.XA (November 16)

Head of the Engineering Department of the Newport Technical College—The Director of Education, Education Offices, Charles Street, Newport (November 16).

Graduate Teacher to take classes in **Physics** and **Mathematics** up to Higher School Certificate standard, or Engineering Subjects—The Principal, Stroud and District Technical College, Stroud, Glos. (November 17)

Special Salt Development Officer to the Government of Bengal—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W C 2, quoting E 2057 A (November 24).

Assistant Lecturer in Preparing, Combing and Spinning in the Bradford Technical College—The Director of Education, Town Hall, Bradford (November 24).

Lecturer in Geography—The Registrar, The University, Manchester 13 (November 25).

Senior Assistant in Engineering Department, and a **Lecturer in General Engineering Subjects**, in the Burnley Municipal College—The Director of Education, Education Offices, Burnley (November 26)

Drilling Engineer for service in the Sudan, on the operation of Drilling Plant, and well digging under the direction of the Sudan Government Geologist—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W C.2, quoting C 2855.A (November 26).

Assistant Examiner of Questioned Documents, Government of India—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting F 5101 A (November 26).

Engineering Assistant (completed A M I C.E. examination), a **Junior Engineering Assistant** (completed A.M I C E examination) and a **Junior Engineering Assistant** (not completed A.M I.C.E examination), on the staff of the Engineer of the River Ouse Catchment Board—The Clerk of the Board, 7 Langcliffe Avenue, Harrogat (November 28).

Director of Museums—The Town Clerk, Municipal Buildings Dale Street, Liverpool 2, endorsed 'Director of Museums' (Novembe 30)

Civil, Mechanical and Electrical Engineers in Malaya an Hong Kong—Civil Engineers (Ref. E.2097 A) should have had experience of construction of railways or open-line maintenance, alternatively, they should have had experience of construction and maintenance of roads, or of Urban Water Supply and Draining, or of Irrigation and Land Drainage; Mechanical Engineers (Ref C 2904.A) should have had practical experience of power generation and distribution and manufacture of plant used therein; Electrical Engineers (Ref D.1535.A) should have had training in Telegraph, Telephone and Radi Engineering—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W C.2, quoting the appropriat Ref. No. (November 30).

Lecturer in the Department of Naval Architecture—Th Registrar, King's College, Newcastle-upon-Tyne (November 30).

Assistant Registrar in the Medical School—The Registrar, King' College, Newcastle-upon-Tyne (November 30)

Lecturer in the Department of Bacteriology—The Registrar, King's College, Newcastle-upon-Tyne (November 30).

Lecturer in Geography—The Secretary, The University, Edinburgh (November 30)

Assistant Lecturer in Inorganic and Physical Chemistry—The Acting Registrar, Queen Mary College, Mile End Road, London, E.1 (November 30).

Assistant Lecturer in Mechanical Engineering—The Clerk to the Governors, Battersea Polytechnic, Battersea, London, S.W.11 (December 14).

Research Worker in the **Pomology Section** for field experiments, and an **Assistant Mycologist and Bacteriologist** in the Plant Pathology Section—The Secretary, East Malling Research Station, Maidstone, Kent (December 15).

Reader in Zoology and **Head of the Department of Zoology** in the Durham Colleges—The Registrar, University of Durham Office, 46 North Bailey, Durham (December 31)

Professor of Physics, a **Professor of Agriculture**, a **Professor of Agricultural Economics** (who is also Adviser in Agricultura Economics for Wales), and the **Gregynog Chair of Geography and Anthropology**—The Registrar, University College of Wales, Aberystwyth (December 31).

Assistant Lecturer in Mathematics—The Registrar, The University, Sheffield (December 31).

Entomologist, and a **Plant Pathologist**, at the Tobacco Research Station, Trelawney, Southern Rhodesia—The Chairman, Tobacco Research Board, P.O. Box 387, Salisbury, Southern Rhodesia (December 31).

Assistant Lecturer (Grade III) **in the Department of Metallurgy**—The Registrar, The University, Liverpool (January 1)

Principal—The Secretary, King's College of Household and Socia Science, c/o University College, Leicester (January 1).

Sub-Librarian—The Secretary, The University, Aberdeen (February 15).

Lecturer in Physiology—The Registrar, The University, Leeds, 2 (February 16)

Secretary—The Secretary, Executive Council of the Imperia Agricultural Bureaux, 2 Queen Anne's Gate Buildings, Dartmout Street, London, S.W.1 (April 7).

Lecturer in the Department of Mechanical Engineering—The Principal, Birmingham Central Technical College, Suffolk Street Birmingham 1.

Teacher (full-time) **of Engineering Subjects**—The Principal Workington Technical College, Workington, Cumberland.

Teacher (Graduate, or equivalent) with industrial experience in Engineering and qualified to teach **Electrical Engineering** to th Ordinary National Certificate stage—The Principal, Technical College, Stretford, Lancs.

Lecturer (full-time) **in the Department of Mathematics**—Th Secretary, Northampton Polytechnic, St. John Street, London, E.C.1.

Lecturer (full-time) highly qualified in **Mathematics**, for advance Engineering Courses preparing for Final B.Sc. and Higher Nationa Certificate—The Organizer of Further Education in Rugby, College o Technology and Arts, Eastlands, Rugby.

Laboratory Attendant for Physics Laboratory—The Secretary to the Governors, Royal Holloway College, Englefield Green, Surrey.

Lecturer (full-time) **in Mathematics**—The Principal, College o Technology and Commerce, Leicester.

Assistant (with a special knowledge of Physical Chemistry) **in th Department of Chemistry**—The Secretary, The University, Aberdeen.

Laboratory Steward in the Department of Botany—The Hea of the Department of Botany, University College, Hull

Graduate Physical Chemist with an aptitude for scientific researc to work on the permeability of packaging materials and packages t gases, and a **Graduate Physical Chemist** with an aptitude fo scientific research to work on the physical and chemical propertie of adhesives used in the packaging and printing industries—Th Director of Research, Printing and Allied Trades Research Association Charterhouse Chambers, Charterhouse Square, London, E C 1.

Senior Physicist to organize and collate investigations on th physical properties of leather—The Director, British Leather Manufacturers' Research Association, 1–6 Nelson Square, London, S.E 1.

Laboratory Assistants (men or women) for work in pharmacological laboratories, and **Pharmacological Assistants** (men o women)—The Secretary, Wellcome Laboratories of Tropical Medicine 183 Euston Road, London, N.W.1.

Laboratory Assistant in the Division of Histology—Th Bursar, Royal Veterinary College, Camden Town, London, N.W.1.

NATURE

lo. 3968 SATURDAY, NOVEMBER 17, 1945 Vol. 156

CONTENTS

Page
m Work in Science 581
estry Problems in the United States. By Prof. . J. Lewis 584
ctricity Supply Organization. By C. W. Marshall . 585
e John Innes Horticultural Institution . . . 586
e Teaching of Analytical Chemistry in Great Britain : ith Special Reference to Microchemistry. By r. Cecil L. Wilson 588
w Basic Concepts in Electrocardiography : the entricular Gradient. By Dr. W. F. Berg . . . 590
peating Compasses. By W. E. May 593
ituary :
Mr. C. S. Middlemiss, C.I.E., F.R.S. By Sir Lewis Fermor, O.B.E., F.R.S. 594
ws and Views 596
ters to the Editors :
Conditions for the Vernal Increase in the Phytoplankton and a Supposed Lag in the Process.—Dr. W. R. G. Atkins, O.B.E., F.R.S. . . . 599
Energy of the Hg—C Bond and the Heat of Atomization of Carbon.—Prof. N. V. Sidgwick, F.R.S., and H. D. Springall 599
Time Factor in Service Tension Measurement.—Dr. C. C. Addison 600
3 : 4-Benzpyrene from Coal Tar.—Dr. I. Berenblum 601
Aluminium Trimethyl.—Dr. H. A. Skinner and Dr. L. E. Sutton 601
Concentration of Solutions of Salts of Penicillin.—Dr. S. W. Challinor and Mrs. MacNaughtan . 602
Sexual Differentiation of the Gonad and the Sexualization of the Germ Cells in Teleosts.—Prof. Umberto D'Ancona 603
Use of Dibenzylphosphoryl Chloride for Phosphorylations.—Dr. A. Deutsch and O. Fernö . 604
Air Photography in the Far East.—Dr. V. J. Chapman 604
ociation of Special Libraries and Information ureaux : Annual Conference 605
emical Composition of Marine Organisms. By . I. Tomkeieff 607

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TEAM WORK IN SCIENCE

IN the accounts of scientific effort during the War on which the veil of secrecy has now been lifted, one common feature stands out on even the most casual reading. Whether we look at the efforts which went to the development of the atomic bomb, of radar, of 'Pluto', 'Fido', and British flame weapons, or in a vastly different field, of penicillin, the extent to which the achievements depend on team work is unmistakable. Sir Cecil Weir was at pains recently to emphasize the way in which in 1942 the Ministry of Supply brought together potential manufacturers of penicillin and interested men of science, and the fact that production was under way or about to commence in twelve factories run by eight firms was the direct outcome of the team work thus engendered. As a particular instance is the help given by experts of the Medical Research Council, and especially Dr. R. I. N. Greaves, of the Serum Drying Unit, Cambridge, in the design of the freeze-drying plant of the Glaxo penicillin plant at Greenford.

Again, Mr. Geoffrey Lloyd, who was in charge of the Petroleum Warfare Department from its formation in 1940 until the resignation of Mr. Churchill's Government, in reviewing the lessons from petroleum warfare, stressed the immense value of research and development teams, and the advantage, in dealing with a particularly stubborn problem, of getting almost completely separate teams to work from quite different aspects. Research and experiment, while they must be directed towards definite objectives, should proceed on a broad front, and policy control should be elastic. Mr. Geoffrey Lloyd was urging the need for a forward surge over the whole range of creative inquiry and invention for peace purposes, and it would be easy to multiply examples of this need and of the place of team work and co-operation in meeting it.

No field better illustrates this truth than the development of radar, and whether we take the Department of Scientific and Industrial Research's papers released in August by the Ministry of Production, the United States Government account "Radar : a Report on Science at War", or the article "Radar in War and Peace" which Sir Robert Watson-Watt recently contributed to *Nature* (156, 319; Sept. 15, 1945), the extent to which this great scientific achievement depended on a most remarkable integration of pure and applied science is clearly shown. In a statement to a Press conference at the Ministry of Information on August 14, Sir Stafford Cripps attributed to the bringing together of the Air Staff and their scientific advisers, distinguished outside scientific workers with wide contacts and fresh outlook, and the members of the National Physical Laboratory radio team, who had been encouraged by the Radio Research Board in fundamental research going right down to the root of radio problems, the immediate solution of the basic problem of air defence. From the appointment of this committee by Lord Swinton in 1935, considering the great complexity of the subject, progress was rapid, and an official document, cited by Sir Robert

Watson-Watt, describes the formation of this Committee for the Scientific Survey of Air Defence, with the contact between a user Department with a great need, and a Department which had fostered scientific discovery not wholly directed towards specific needs, as one of the most important events in our history.

Sir Robert Watson-Watt is at pains to bring out the way the story illustrates the need for encouraging scientific research in all fields and for making the needs of the State known to those who are engaged in scientific research, though he alone in his account passes over his own important contributions in these early developments. No account brings out more clearly than his own, however, the way in which the development of radar is based on Appleton's classical range measurement on the ionosphere and Breit and Tuve's powerful tool, the radio pulse. The beginnings of radiolocation, Sir Robert points out, lay in the work of those who laboured to understand more of the things that happened in the earth's atmosphere. Its later developments, and much of its technique at all times, were due to those who sought the inner secrets of the structure of matter.

Nor was this all. Sir Robert maintains that the most important thing about the British development of radiolocation is that it happened at the right time, and the essential differences between the British effort and that in other countries is to be found in the intangible factors which assured to us at each stage in development at least an adequate margin of time for meeting the successive crises of the War. Britain was a prominent leader in ionosphere research, and those researches were State-aided and generously and lightly State-controlled, and Sir Robert considers that without the peaceful pursuits of the Radio Research Board in general and of Sir Edward Appleton and his colleagues in ionospheric research in particular, radiolocation would have come too late to have any decisive influence in the War. Further, the Radio Research Board had trained a team of young research workers encouraged to see and explore the whole gap between the Morse key and the loudspeaker, and while turning their vision and imagination generally towards application, taking neither narrow nor short views. Sir Robert again stresses the importance of the spiritual ingredients—wisdom, sound judgment and courage—in the scientific advisers, the scientific workers, and the administrative officers who staked some millions of pounds of public money and revised the air defence system of the country ; but the most significant factor was the unprecedented and unprecedentedly productive interplay between scientific and operational minds, which carried the basic technique from its first defensive application in an early warning system through more actively defensive phases to a wealth of offensive applications which had a decisive effect in every major phase of the War.

This intimate co-operation of scientific and military minds, he suggests, will remain as the real secret weapon in the British armoury. Nowhere else has there been a parallel to the practice followed from the first days of radiolocation research. This fruitful co-operation, moreover, extended to the selection training of personnel to operate and maintain systems, to the evolution and practising of tact methods based on the systems, and to the wl complex of technical, tactical and logistic proble involved in introducing new scientific devices i heavily engaged operational formations.

Even that valuable tradition of constructive del between General and junior scientific officer and the extricable weaving of contributions from operatic officer and scientific worker is not the only lessoi co-operation and team work that radiolocation to teach. Almost equally impressive is Sir Robe picture of the building up into a single team of later and much more numerous recruits, not me the cream of the physical research laboratories of country but also chemists, physiologists, biologi dons and schoolmasters, united by certain b characteristics common to all branches of scie This whole combination of technical objectivity the highest technical skill in one team, coupled w the remarkable organization for rapid production team work on the part of industry to which Stafford Cripps has paid tribute in addressing Council of the Radio Industry, is indeed, as Robert suggests, even more important and signific than the technical devices issuing from it.

Moreover, in this there was the partnership built between the Government establishments, the univ sities and the industrial laboratories, and beyo that the pooling from the time of the Tizard miss in 1940 onward of British and American informat over the whole field of radiolocation. The arran ments made for the interchange of information tween the United States and the British Comm wealth, following on this first pooling of knowle and ideas, were reinforced by the community interest and understanding which at all times li the leading scientific workers in friendly fellowship well as by the intimate contact with operatio needs which the British workers, as Sir Robert sho enjoyed from the start. In sum, the joint effo have led to results which have not only been righ described as the heart of our war effort, but n well prove to hold the key to success in the t of reconstruction.

Equally impressive is the picture of war inve gations carried out by large groups which Prof. C. Lander gave in his Melchett lecture, "Team Work Research". These investigations covered combust work in connexion with gas turbines and jet p pulsion, research and development of a model law predict performances of flame-throwers, and resea and development on petrol burners and their supp and signalling arrangements for fog dispersal on ae dromes. Prof. Lander, moreover, points out that his own experience in peace-time, when he starting the survey of the coal resources of Gr Britain, he had been faced with the problem knitting together the contributions of organic, organic and physical chemists ; of physicists, g logists, zoologists, botanists and palæobotanists ; mining, civil and mechanical engineers ; and of and fuel technologists.

Much of Prof. Lander's lecture was of technical interest, but he was at pains to stress the importance of the task of the team leader in holding the balance between the specialized advices of his team members; and he insisted that such a leader must above all possess that critical sense which is based on a wide experience and broad knowledge of scientific work. A team leader must also possess sufficient knowledge of the various sciences to enable him to follow the reasoning of the individual members of the team. Prof. Lander gave little indication as to how the organization of such a team should be built up, though his whole lecture was a challenge to narrow specialization in technical education. He recognized that the team leader requires breadth of understanding in the human as well as the technical sense, but he did not indicate so clearly as Sir Robert Watson-Watt that the members of the team should themselves possess similar qualities to some extent, particularly a capacity for the self-criticism necessary for realizing the possibility of bias and for generating toleration for the inevitable bias in others. It will be noted, however, that while Prof. Lander recognized that secrecy may be necessary, at any rate for the time, he stressed the great importance of publication, especially publication under the names of the men responsible for the particular pieces of work.

It is against the background of this experience and the lessons it enforces that we have to regard in fact future proposals for the organization of research and development, whether in industry, in the Government service or in the universities themselves. Proposals for the reorganization and recruitment of the scientific civil service, for the expansion of industrial research, and for university development must be considered from the point of view of how far they embody the relevant lessons of this war-time experience of team work and the full and free interchange of knowledge and ideas. These are not, of course, the sole criteria, but no proposals which fail to foster the outlook and the temper of mind in which team work of this kind flourishes best can well be entertained except on the basis of the most powerful and convincing reasons.

The two most impressive features of this particular aspect of radiolocation team work in development and research which are stressed not only by Sir Robert Watson-Watt, but also in the British and the United States official accounts, are indeed in regard to the interchange of information and the treatment of scientific staff. No one who has followed at all closely reports or statements on scientific and industrial research, such as that of Nuffield College, during the last two years or so, or studied the recent report of the Barlow Committee on Scientific Staff or, on the American side, those of Dr. Vannevar Bush and his advisory committees, can fail to note how well in line with precept and principles stressed in those documents practice has been. The team work on which the success of radar is firmly based is in fact a demonstration of the soundness of principles long pressed in these columns as essential for scientific advance and which must be far more widely applied in industry and in Government if our scientific resources are to meet adequately the new and immense demands of peace.

The interchange of information provides a highly instructive example. The critical importance of secrecy in regard to radar is unquestionable. None the less, this overriding demand for secrecy was not allowed to obstruct or exclude that close contact of mind and free and full discussion so essential to the fertilization of ideas, to constructive and creative thought and to scientific advance. The conditions for the stimulation of scientific thought and imaginative enterprise were secured. The instrument was limited to its purpose and was never allowed to become the master; and there is no more satisfactory feature in the Government's proposals for a scientific civil service than the statement that it views sympathetically the recommendation that secrecy restrictions should be relaxed as much as possible, and scientific workers in Government service encouraged both to publish work of their own and to discuss their work with persons outside the Service engaged on similar problems.

That is a *sine qua non* of effective team work and co-operation, whether between departments, between industry, the Government or the universities. Scientific workers have given clear indications in recent months that they recognize the importance of restoring as quickly as possible full freedom of scientific communications, and it is to be hoped that neither in Britain nor in America will they miss the implications of radar but will insist on an improvement on, and not merely a return to, pre-war conditions in this respect. Freedom to know, to utter and to argue freely according to conscience is a fundamental condition of scientific advance. Radar provides a convincing demonstration that a solution of the problem of secrecy is possible on some such lines as those suggested by the Barlow Committee—that such freedom can be responsibly exercised.

A solution of this problem is essential if we are to attract to the services of the State the ablest scientific minds of each generation and if we are to make the most effective and best use of such minds in the employment of the State, of industry or of the universities. It is of course a special aspect, as the Barlow Committee recognizes, of breaking down the isolation of the scientific worker, whether or not he is employed in the Government service. Moreover, the further measures proposed for dealing with that isolation of the scientific worker in Government departments through the encouragement of mobility and interchange of staff and the introduction of the sabbatical year and the like, which the superannuation proposals of the Government are designed to assist, are exactly the type of measure equally adapted to break down departmentalism anywhere and that compartmentalism of mind whether in teaching or research to which the specialist is ever liable. Sir Robert Watson-Watt shows the brilliant success which has attended the elimination of such isolation and compartmentalism in the development of radiolocation. That very success calls for the closest study of the technique of organization by which it has been achieved, and it may confidently be predicted that the careful study of the factors responsible for such outstanding team work, and the application of the lessons of that experience in the elaboration of our post-war research structure, in Government departments, in industry and in the universities, will pay equally rich dividends.

Radar research has provided a convincing demonstration, not merely of the possibility of highly productive team work, but also of its existence side by side with conditions which favour creative work and encourage the originality and individuality, initiative and enthusiasm which are all-important in the advance of science. Here have been found and maintained exactly those conditions, those methods of treating the scientific worker so that the utmost use is made of his inherent abilities ; and no strategy of research which ignores such tactical measures is likely to achieve success. As we face the problems of reconstruction and the acute shortage of man-power which persists and is likely to remain with us, we do well to recall the reminder of an early report from the Select Committee on National Expenditure that the main need is a better use of the available forces rather than an increase in their number. Above all it is true of scientific man-power that efficient use depends not merely on having at our disposal an adequately staffed intelligence organization provided with ample means for collecting and interpreting the relevant data on the problems to be solved and determining their priorities, but also on giving to the human factor the right attention and treatment to enlist and hold its enthusiasm and highest creative and imaginative powers.

FORESTRY PROBLEMS IN THE UNITED STATES

Behold our Green Mansions

A Book about American Forests. By Richard H. D. Boerker. Pp. xvi+313+96 plates. (Chapel Hill, N.C. : University of North Carolina Press ; London : Oxford University Press, 1945.) 24*s.* net.

THIS is a book about forests in North America : forest conservation, soil conservation, timber, flood control, wild life, grazing, scenic beauty, recreation and the use of timber. All these are subjects very much under consideration at the present time, and most of them interest the general reader and all of them are of first-rate scientific importance. The subject-matter is based entirely on American experience, and brings out the scale of operations there in comparison with those in Great Britain and with the latter's small-scale problems and comparatively small climatic fluctuations. The subject is of importance in all the continental areas in the temperate zone, and the same disquieting condition is found everywhere—depleted forests causing soil movement, and an ever-expanding demand for timber.

Man's attempt at settlement in new countries has often been accompanied by a failure to recognize the dangers of interference with natural phenomena without a very detailed scientific knowledge of the factors involved. Interference with the natural cover of vegetation has nearly always been the cause disaster. This process is well seen in the Unit States where, according to the U.S. Forest Servi only seven-eighths of the original virgin forest left. This is illustrated in the work under conside tion by three diagrams of forest areas dated 16 1850 and 1942. While there is little difference betwe 1620 and 1850, the 1942 map shows these virg forest areas as very small and detached patches. is during this latter period that the problem of s erosion has arisen.

We have been accustomed to think of America a land where natural resources are so rich as to almost inexhaustible. Mr. Boerker starts by destro ing this myth regarding America's forest weal During the War, timber was classified as a criti war material, and the forests were called upon fo tremendous output of material essential to t prosecution of the War. This was met, but was han capped—as he explains in an interesting preface "by our past gross neglect of our forests". He sho how through forest fires, bad and unscientific cutti of timber, through ignorance and for quick gain, a by indiscriminate cutting down of forest lands farming, serious inroads have been made on timb resources. However, this is the negative side of t picture ; he goes on to show what is being do through conservation and re-afforestation to reme this deficiency. But as he says, "it is one thing gather scientific data and lay out a plan of actio but it is quite another thing to acquaint the fore using public with the facts". This is what this bo claims to do, and in this the author has succeed well.

The forest is treated in its relation to wild li water supply, holding the soil, flood control and as live-stock range.

With regard to wild life, the author gives e amples of the delicacy of balance between speci and quotes instances of disastrous control due ignorance of inter-relationships. In fact, mar attempts—in the absence of expert knowledge— control Nature has often been as disastrous as destruction of it for profit. This aspect is close bound up with the importance of the forest as region of recreation for the people. But with t artificial management of the forests, game laws ha to be tightened or liberalized in proportion to t food available.

The many factors affecting forests in regard water supply are complex, but broadly speakin forests conserve water and prevent rapid run- causing erosion. Not only the trees of the fore but also the ground vegetation of flowering herbaceo plants and shrubs, mosses, liverworts, lichens are interdependent and act as anti-erosion agents. northern regions these also retain snow and slow do its melting and run-off. Every type of forest has characteristic undergrowth, and the balance is oft a delicate one. Soil erosion is a world-wide proble and while much of it is due to the destruction of fore the breaking of natural grassland is equally structive in semi-arid regions, where the erosion m be due to sudden storms or more frequently to stro winds.

Of the destructive agents the author has much interest to say. While fire on a large scale is not problem in Britain, it is a real menace whe hundreds of miles of unbroken forest may occur, in America, and where much lower relative humidi is encountered than in western Europe.

Boerker gives an excellent description of such ires, which enables the reader to realize what formidable destructive agents they are. A good idea of he elaborate system of fire-watching and fire-fighting measures taken in the United States can be gathered rom this book, and the reader is impressed by the well-organized scale on which these preventive measures are carried out. In spite of all this, the annual loss of timber is very great. This is well llustrated by one example—"one of the most serious of recent fires was the big Wilson fire of August 1933 in Oregon started by friction from a steel cable passing round a dry stump. Over 260,000 acres of the finest virgin forest timber was burnt. The loss to the public and to labour was computed to be in excess of $350,000,000." In this one fire alone an amount of timber was destroyed equal in total to the entire timber cut of the United States for 1932.

To make good the wastage due to human carelessness and to almost unavoidable accident, re-afforestation has to be carried out on a similar scale by both private timber companies and the State Conservation Department. These efforts are not only designed to re-forest burnt-over areas but also to return abandoned farm land to forest.

The United States have carried out a well-planned and comprehensive scheme of juvenile and adult education on the preservation and development of their forest resources, as well as setting aside extensive areas as national parks. The work begins in the schools and is carried on later by numerous societies, of which the author mentions a number of the more mportant. The United States and Canada form one of the greatest centres of coniferous forests in the world, and although man has greatly depleted this, wise measures of conservation and large-scale schemes of re-afforestation still make the North American continent the chief area of supplies of coniferous imber.

This book is of great interest to the general reader, for it deals in a most interesting fashion with a subject hat concerns all of us. It is of equal interest to the scientific man, and appeals particularly to the botanist and the plant ecologist. A word of praise must be added for the many beautiful plates which accompany he text. Many of these were taken by the U.S. Forest Service, some by the U.S. Soil Conservation Service, and a certain number were obtained from private sources.

F. J. LEWIS.

ELECTRICITY SUPPLY ORGANIZATION

lectricity—Public or Private Monopoly?

By F. Hamlyn Dennis. Pp. iv+143. (London: Victor Gollancz, Ltd., 1945.) 7*s*. 6*d*. net.

ELECTRICITY supply takes a high place in the list of major public services which are scheduled or reorganization by the Government now in power in Great Britain. Its political prominence is not a new development, as Parliament has given considerable attention to co-ordination of electricity supply ever since the War of 1914–18 revealed the deficiencies of separate power systems serving comparatively limited areas.

The book under review provides ample information regarding the various steps which led to the existing Grid supply system, but it may be useful to summarize these steps for the information of readers not intimately connected with the supply industry.

The Electricity (Supply) Act of 1919 established the Electricity Commissioners, who endeavoured to co-ordinate the British systems by establishing joint electricity authorities which grouped adjacent undertakings to form larger and more economical units. Their efforts had so little success that it proved necessary to pass the 1926 Electricity (Supply) Act and thereby establish the Grid system controlled by the Central Electricity Board.

The Grid provides for the co-operative working of all electrical generating stations in Great Britain. It has been in operation since 1930, and has been effective in improving the average thermal efficiency by some 15 per cent. All generating plant has become generally available instead of only locally, and the savings in capital costs in power stations have offset the cost of providing the Grid equipment. During the War the Grid was of inestimable value in assuring continuity of electricity supplies throughout the country. This great technical and economic success of the Grid has been an important factor in focusing attention on the vital question of ownership of undertakings.

Mr. Dennis is a whole-hearted advocate of public ownership, and he does his best to justify his preference by revealing the fact that power companies charge more for electricity than do municipalities. He also takes great care to reveal the sources of his information, and these sources are usually the best which are available to the public. He presses home his main contention by disinterring from *The Economist* of July 4, 1936, a rather sour estimate of the efficiency of power companies: "Company-owned undertakings, by and large, have shown neither outstanding commercial efficiency in the pursuit of their own interests, nor over-much zeal for those of the consumer". This thrust would have been more effective had it been illustrated by analysing the production costs of typical undertakings. In the reviewer's opinion, the absence of such analyses conduces to inefficiency.

A 'unit' of electricity costs about 1*d*. The public are notoriously careless of pence and tolerate extortionate percentage increases of cheap articles without taking much notice.

The authorized undertakings are able to continue to operate at comparatively low efficiency because they sell much of their output directly to the uncritical and uninformed public, and because they exploit the situation to a comparatively small extent.

As a first step towards real economy in electricity supply, the reviewer suggests publication of costs of electricity to the consumer in the form of league tables. These would reveal the facts in a way which would appeal to the British public, and if they did not cause the inefficient undertakers to improve, governmental action could be taken. To ensure that there will be no premature change over to civil service control, the relative efficiencies of the General Post Office telephone service and of the power companies should be examined. The reviewer suggests that such an examination would have a sobering effect on Mr. Dennis and his co-enthusiasts.

The book is recommended as being one of the most convenient and interesting sources of information on British electricity supply.

C. W. MARSHALL.

THE JOHN INNES HORTICULTURAL INSTITUTION

THE John Innes Horticultural Institution is to move from Merton to a new site at Bayfordbury in Hertfordshire. The move will mean a radical change in the scale of work and the opportunities for studying the problems of horticulture. It is therefore worth while considering these prospects in relation to the past work and development of the Institution.

The foundation was due to a private bequest. When Mr. John Innes died at Merton in 1904, he left the greater part of his fortune to endow an institution to be set up at Merton "for the improvement of horticulture". In 1909, the Charity Commissioners approved a scheme for the new Institution which was to concern itself, on one hand, with the training of gardeners and, on the other hand, with "research, whether of a scientific or practical nature, into any matters having reference to the growth of trees and plants generally".

The administering Council represented universities and public bodies, including the Ministry of Agriculture. The first step it took was in the choice of a director. This step was decisive, for the choice was William Bateson. At this time Bateson was not only an outstanding personality in British science, but he was also engaged in the tremendous struggle—not yet won in his own country—to establish the new science of genetics. In British universities no facilities existed for research in genetics, and its teaching met with opposition rather than encouragement. To Bateson, therefore, the appointment meant a foothold, a first secure foothold, for genetical research in Britain. To the new foundation it meant a policy and a programme which filled a gap in the national development of science. At the same time, the terms of the foundation required, or ensured, that the fundamental methods of inquiry introduced by Bateson should be applied and taught on the spot. The Institution has therefore always held pure research and applied research equally balanced, using each to feed the other. Following this habit, it has always been able to attack its own problems in its own way, and its programme has been a self-propagating one.

The new theories and techniques had to be fitted into the larger framework of science, and, in the process, some false steps were taken, as indeed they were bound to be. The first appointment to the staff, however, was a success: E. J. Allard, a fine gardener and a wise teacher, was made curator. From the first, too, the genetic work with fruit crops met with success. M. B. Crane, who was one of the earliest products of the new training, was put in charge of this branch in 1919. The full possibilities of plant breeding, however, waited upon the second decisive step in the development of the Institution This step was taken by Bateson following his visit t the headquarters of the *Drosophila* school in 1921 He then realized that the next great advances i genetics would demand that the study of chromosomes should go hand in hand with experimenta breeding. He accordingly invited the late W. C. F Newton to establish this second new theory an technique at Merton. Once again a serious gap in th national scheme of research was filled by Bateson' initiative. A school developed, and foreign worker played an important part in its growth. Vavilov an Sturtevant, and later Karpechenko, Belar an Müntzing made their varied contributions to th work; and the visits of Johannsen and Morgan Lotsy, Winge and Mohr, Driesch, Baur and Goldschmidt enlivened the frequent and often length arguments in the library, laboratories and fields a Merton.

BAYFORDBURY, THE NEW HOME OF THE JOHN INNES HORTICULTURAL INSTITUTION

After Bateson's sudden death in 1926, the sam policies were continued by Sir Daniel Hall. But ver naturally a synthesis also began to take place ndelian experiment and chromosome observation re combined in the work of J. B. S. Haldane and, a different way, in that of C. D. Darlington. The ndations of plant breeding, especially in the fruits, re changed by the discovery of polyploid series ated in various ways to hybridization and recom- ation, as well as to fertility and vigour. At the ne time, to meet the exacting needs of plant eding, improvements in the quality and precision glasshouse cultivation were demanded. W. J. C. wrence, Allard's successor, and a second of the stitution's own students, achieved these improve- nts, and the fruits of his success have been reaped the industry at large.

In October 1939 Sir Daniel Hall was succeeded as ector by C. D. Darlington. In spite of war condi- ns, K. Mather, now head of the Genetics Depart- nt, was able to introduce and perfect another new entific method. It was based on applying the ndelian and chromosome theories in combination h Fisher's statistical methods. It made use of allel studies on quantitative inheritance, or con- uous variation, in the fly *Drosophila* and in crop nts. The results have an undoubted practical ring on plant breeding; and they also have the damental value that they finally reconcile the d-dying conflicts of Darwinian and Mendelian ory, of biometry and genetics. During the same iod, at several angles, chromosome studies have n shown in their broad and fundamental bearing medical research, in the recognition, etiology, and ray treatment of cancer, and in the understanding the development of the blood. With new methods study of the cell is proving to be as useful in the proach to development and disease as it has been the approach to heredity.

During the War, the scientific staff was reduced m sixteen to six, and long-term projects had of rse to be replaced in part by more immediately ful trials and experiments. The practical results this work have been made known to the grower d cultivator by leaflets, bulletins and by advisory vice. These activities will doubtless have to remain er the War: it is clearly not enough for the harvest research to be stored—or buried—in libraries. ture developments, however, will depend on the cess of the major operation of transplanting the stitution and on its economic situation afterwards.

When the permanent buildings, laboratories and sshouses were put up in 1910, it was already own from A. D. Hall's report that the site and soil re poorly suited to the purpose. Both went from l to worse. The vicinity was clothed with suburb er the last War; the air was polluted, the sunlight down, the water-table lowered, the garden pests ltiplied and strengthened, while miles of houses d factories cut off all avenue for expansion and all tact with the one industry that mattered. As t as its building value went up, the horticultural ue of the land went down. The workers outgrew laboratories, the books outgrew the library, the eriments outgrew the gardens. Setting up over- w stations could merely postpone the decision. ew site had to be found.

nquiries for new land were begun in 1938. They tinued over a wide area for seven years. The lity and drainage of the soil, the atmosphere and nate, the water and electricity supply, the availa- ty of buildings, the accessibility to town and versity, all had to be taken into account. Com- cial value also had to be regarded. The Institution's revenue, reduced in 1931, was still further curtailed in 1941 by the war damage in London, which was even more serious in its financial effects than the direct destruction at Merton in 1944.

The John Innes Trustees have chosen a site which meets these various requirements better than had seemed possible. They are exchanging 19 acres at Merton for 372 acres on the new site. While Merton is eight miles from the centre of London, Bayfordbury is sixteen miles away. It is one mile from Bayford Station and less than a mile from the outskirts of Hertford. Yet the district, for the last hundred years, has been unfashionable enough to have remained rural. Indeed Bayford (to quote the Greater London Plan, 1944) "is in the centre of a very extensive belt of woodland . . . one of the few really unspoilt tracts of land near London, from which it is readily accessible". The soil is based on glacial drift over chalk and varies from a light to a medium-heavy loam. The land lies on the south side of the River Lea, and rises a hundred feet above it. The slopes should give safety from frost without undue exposure to wind. Conditions so favourable as these are not easily found near London.

Bayfordbury was built in the years after 1759 by William Baker, nephew-in-law of Tonson, the publisher of Milton and Dryden. Until this year it housed the collection of Kneller's portraits of his forty-two friends or clients, members of the Kit Cat Club, which has now been acquired by the nation. The profits of "Paradise Lost" paid for a substantial building. The mansion is conveniently designed and centrally placed. It is handsomely sited between two groups of cedars of its own age. A lake near by, fed by surface drainage, affords a plentiful supply of water for irrigation. The woodlands include the collection of conifers, occupying ten acres and recorded in the four-volume work of Clinton-Baker and Jackson. This collection was established in 1838 by W. R. Baker with the advice of Loudon. Now it might well prove of value in the study and breeding of both ornamental and timber trees.

The mansion and outbuildings provide nearly twice the accommodation at present available at Merton. Some of this will be useful for domestic housing. But even with the six additional cottages it will clearly not go far towards solving the housing problem. With their dependants, the staff number, in peacetime, about 120, and under present conditions their removal as a whole to a new locality will demand new housing. The necessary building will probably not be completed for two years or more.

The question remains as to why such a sudden expansion of area is made. Can profitable use be made of so large an area for horticultural, and especially genetic, research? The original land purchased at Merton was five acres, and only piece by piece were acres added to it—so long as they could be added, and always at an increased price. Other research stations have suffered from outgrowing their land after twenty or thirty years with like consequences. The Royal Botanic Gardens, Kew, were larger and the difficulty came late but, having come, proves insuperable. With the Royal Horticultural Society's gardens at Chiswick the difficulty was overcome by removal; and the new gardens at Wisley, like those at Kew, are of similar size to Bayfordbury. Of the 372 acres in the new estate, no more than 150 acres will, it is expected, be taken up for research purposes in the next ten years. But the choice of a larger area for the John Innes land is based on the expectations of fifty years. It is also based on the view that the need for research, and the understanding of that need, are likely to grow beyond our present computations. This view takes into account two lessons of the war period. One is that horticulture has changed from an incidental luxury into a necessary part of the nation's economy. The other is that genetics has changed from an ornament of research to one of the main props of science.

In its new habitation, the John Innes Institution will undoubtedly undergo a transformation. But there seems no reason why it should forsake the character or the aim for which it has been valued. Its aim will no doubt continue to be to unite theory with practice and to combine a freedom of initiative with some coherence of purpose within the wide range of activities allowed by its foundation.

THE TEACHING OF ANALYTICAL CHEMISTRY IN GREAT BRITAIN: WITH SPECIAL REFERENCE TO MICROCHEMISTRY

By Dr. CECIL L. WILSON

FOR some time past it has not been possible to make any accurate estimate of how the demand for microchemical teaching in the British Isles has been met. Previously, the only guide in this direction was the list, probably not altogether comprehensive, published from time to time in *Mikrochemie* before the War. As a consequence, discussion of the teaching of microchemistry must of necessity have been based largely on estimates derived solely from personal contacts and hearsay, and any statement about it was justly open to doubt.

The only satisfactory way to clear up the position was by means of some sort of census. This was scarcely an undertaking for a private individual. The recent formation of the Microchemistry Group of the Society of Public Analysts and Other Analytical Chemists, however, provided an official body to which the information is of first importance. At the request of the Committee of this Group (under the chairmanship of Prof. H. V. A. Briscoe, Imperial College of Science and Technology, London), therefore, a questionnaire was drawn up, the answers to which would clarify the position of the teaching of modern analytical methods, and, in particular, of microchemistry. This questionnaire has been circulated to 85 centres of higher chemical education in the British Isles, comprising 43 universities, university colleges and university institutes, and 42 technical institutions. Replies have been received from 64 of the institutions —75 per cent of the total covered—made up of 32 universities and their institutes and 32 technical colleges. The information contained in the replies has been collated, and forms the basis of this report.

It was difficult to draw up a questionnaire which would cover the situation both completely and in detail. In fact, study of the replies suggests that such an achievement would have been impossible. But it must be acknowledged that most of the institutions received the questionnaire in an extremely helpful spirit, and did their best to interpret doubtful questions so as to supply the maximum of useful information. Many institutions made valuable additional comments, and it is perhaps in these that most food for thought will be found.

In spite of this co-operation, some points w
missed completely, while others still remain vag
For example, as was pointed out in one reply,
question which should have been asked, and was n
concerned the number of microchemical balan
possessed by each institution. Answers to this mi
conceivably have been useful in clearing up cert
vagueness in other replies. Again, confusion
nomenclature, more particularly as between
terms 'micro' and 'semi-micro', is apparent; wh
some institutions probably put a much wider int
pretation than was intended on a question wh
asked for information about *special* courses deali
with modern analytical techniques. This gives
to doubts as to whether the teaching of any of t
more modern techniques is really as advanced as
suggested by a superficial study of the replies.

As a consequence, it has been necessary, in repo
ing, to interpret equally broadly on occasion. But
is felt that, at least so far as microchemistry is c
cerned, this summary presents a much more cohere
and truthful picture than has hitherto been availab
Where it has been thought desirable, distinction
been made between the technical colleges and
universities, as the conditions ruling in each of th
groups, and controlling their activities, are marke
different in many ways.

Modern Analytical Methods

Of the 64 institutions replying, 25 normally tea
electrochemical analysis, 16 teach spectrograp
analysis, and 25 teach electrometric methods. O
or two of these courses of instruction have be
interrupted owing to the War. In addition, 5 insti
tions teach the use of the polarograph, 12 colorimet
photometry, 2 metallurgical analysis, and 10 rep
miscellaneous or unspecified courses.

It is probable, as already suggested, that in ma
cases this instruction merely forms part of an existi
course in general chemistry, and is not a spec
course. There are, however, certain institutions
replies from which indicate clearly that in their c
the courses *are* special ones dealing only with
methods specified, in a reasonably detailed fash
Only 3 of the institutions replying possess a spec
lectureship in analytical chemistry. However,
other institutions find it necessary to qualify
negative reply by stating either that they have
lecturer concerned solely or almost solely with t
branch of work, or that such a lectureship is desira
or projected.

Microchemistry

In all, 43 of the institutions, that is, almost 70
cent, have taught or teach microchemistry in so
form or another.

The first course in microchemistry in Brit
appears to have been established in 1929. Of the
institutions which give a date for the commencem
of their course or courses, 16 started prior to
War, only 4 since. This is quite to be expected.
peak years for new courses were around 1936–38.

Estimates were given by 22 institutions of the ti
spent on micro work. These estimates range, rat
startlingly, from 4 hours per student to 300 hou
Examining these figures rather more closely,
average value for the 22 institutions is just over
hours per student. Of the individual estimates, 6
above the 100-hour mark, and 12 above 50 ho
Rather surprisingly, these figures are distributed fa
equally between universities and technical colleges

In Table 1, which indicates roughly the grading of he courses, those referred to as "current" are running t present. Those designated "pre-war" were in existnce before the War, but have since been suspended. hus the total of these two gives some measure of the robable *minimum* number of courses which would be n existence at present, had it not been for the War.

TABLE 1.

	Universities	Technical Colleges	Total
pecial Postgraduate Courses:			
Current	4	3	7
Pre-war	1	5	6
Total	5	8	13
pecial Undergraduate Courses:			
Current	2	3	5
Pre-war	1	1	2
Total	3	4	7
outine Instruction to Undergraduates:			
Current	11	10	21
Pre-war	6	5	11
Total	17	15	32

As this shows, of 64 institutions, there should be, fter the War, at least 52 potential courses in the ractice of some form of micro methods—25 in niversities, and 27 in technical colleges. In fact, his figure is almost certainly an under-estimate, as everal institutions report projected courses, not ncluded in Table 1, which have not yet materialized ecause of the War.

The outstanding point that is brought out here, owever, is the impressive number of institutions—0 per cent—which have found it advisable to introuce microchemistry to some extent as routine ractice for students. This is concrete proof—perhaps he first to be produced—of the appeal and usefulness f micro methods in teaching in Britain. It gives very justification for the recognition of these methods y examining bodies which control external examinations, thus enabling those institutions which teach or such examinations to do so on an equal footing with those which include microchemistry in courses or internal examinations, and with an equal claim o modernity.

Further details of the type of instruction are abluated in Table 2:

TABLE 2.

	Universities	Technical Colleges	Total
uantitative Organic Analysis	13	15	28
ualitative Inorganic Analysis	9	18	27
uantitative Inorganic Analysis	10	11	21
hysicochemical Methods	8	9	17
nthetic Organic Methods	7	9	16
ualitative Organic Analysis	5	7	12
hemical Microscopy	4	2	6

Semi-micro methods are taught, either in connction with, or as an alternative to, full micro ethods (it is not always clear which) as shown in able 3.

TABLE 3.

	Total
Quantitative Organic Analysis	13
Synthetic Organic Methods	7
Qualitative Inorganic Analysis	5
Quantitative Inorganic Analysis	4
Qualitative Organic Analysis	4
Physicochemical Methods	2

In the case particularly of the qualitative and nthetic methods, there seems to be considerable nfusion over a distinction between the two scales 'micro' and 'semi-micro'.

In preparing a general report such as this, it is most impossible to give any closer indication of the pe of instruction which prevails. It is felt, however, at it would be of interest to detail the instruction ven at one institution, of moderate size, serving a wn of average population (about 50,000–60,000). his institution, one of the more advanced in this respect, is not, however, necessarily the best. It is chosen rather as showing what can be undertaken by an institution which has only average resources of space, staff and finance, where the will to progress is present. Special courses deal with electrochemical analysis, electrometric methods of analysis, including the use of the "magic eye" apparatus, and absorptiometry. In general analytical chemistry, apparently a special postgraduate course, the following are dealt with: application of organic reagents to inorganic analysis; chromatography; polarography; the electrograph; use of luminescent, redox, adsorption and complex-forming indicators; the high-temperature combustion furnace; survey of the branches of microchemistry, etc. Coming to microchemical courses, these are held both as special undergraduate courses and as part of routine instruction to students. The branches covered include qualitative inorganic analysis, qualitative organic analysis, quantitative organic analysis, physicochemical measurements; synthetic organic methods are to be introduced soon, and quantitative inorganic analysis is taught on the semi-micro scale. The special course occupies two hours per week for its duration. The special remarks section states: "We are teaching micro-methods to National Certificate Students. A special course for final students and graduates is run in the Summer Vacation. It is hoped to extend it to 'outside' people this year".

The reasons given for absence of any, or of fuller, instruction in the various institutions occur in the following order of importance: lack of time (25); lack of staff with the appropriate knowledge (16); the War (14); lack of space (14); lack of apparatus (13); small educational value and limited uses of microchemistry (6). Certain of the answers—lack of staff, lack of space, lack of apparatus—are in some cases qualified by "during the War", these necessities having been loaned for national use.

The last category—small educational value and limited uses—must be read with some reserve, since of the 6 institutions putting it forward, 2 already teach some microchemistry, and 2 others propose introducing some after war conditions have eased.

As already remarked, the additional comments kindly supplied by the different institutions provide much that is of interest. The more important issues which they raise are best illustrated by quotation. Two divergent views of the value of microchemical instruction provide a striking assessment when taken in conjunction: "From educational standpoint, favour Inorganic micro in Third Year". "Micro and semi-micro technique is not taught for its own sake, but merely to improve the experimental technique of the students—mostly with a view to the saving of time". On the other hand, it is stated, "Many of our research investigations demand a good working knowledge of microchemistry in all its branches". "In chemical practice one so frequently has to deal with small quantities". In other words, microchemistry has proved its usefulness, whether it is considered solely as a teaching method or as an analytical tool.

A few of the institutions which already include some microchemical teaching doubt the wisdom of introducing more; but a considerable majority intend to increase substantially the time devoted to the subject when conditions permit.

The low regard in which analytical chemistry tends to be held is specially commented on by several writers: "Modern analytical methods should figure much more prominently in the curriculum of a Technical College than is customary at present". "*Academic* Institutions tend not to give much attention to chemical analysis. It is often quite difficult to make students do *any* accurate work".

Pleas are made for the provision of teaching *for the teacher*. "Vocational courses held at some suitable centre, for the training of teachers in the various branches of microchemical analysis, would be much appreciated". "It is desirable that a summer school for teachers should be established so that they may acquire a first-hand knowledge of the technique required. Prior to the War, such training was difficult to obtain in the British Isles".

The difficulty of the external examination is pointed out: "The chief determining factor is undoubtedly that the University of London and professional bodies generally do not yet demand a knowledge of microchemical technique in their practical examinations". "Omitted of late, since students have to complete their studies in less time than before"; that is, discarded as the first inessential for examinations!

Finally, one comment may be coupled with the difficulties of those who plead lack of apparatus: "For quite a year now we have been unable to do micro organic analysis for research purposes, on account of the balances needing attention. It has not been possible to get even one of the three balances reconditioned".

Without further comment, it may be claimed that a number of conclusions are implicit in this survey. In the first place, there is undoubtedly a general recognition among teachers of the importance of analytical chemistry in general, and microchemical methods have obviously recommended themselves strongly to teachers as a useful instructional topic. Recognition of this by the professional and other examining bodies is desirable, particularly in view of the probable post-war development. Every effort ought to be made to secure this recognition, and to make possible further development of the regard for analytical chemistry in teaching institutions.

In this connexion it is perhaps worthy of stress that the size of the institution and the importance of the area which it serves seem to bear no direct relationship to its attitude to analytical and micro methods. In other words, small institutions are as advanced in this respect as larger ones, whether one considers the apparatus available or the nature and extent of the instruction. Presumably, therefore, development in analytical and microchemical teaching may be regarded as a function of individual endeavour, and further improvement in this respect is not altogether dependent on such physical factors as available funds.

Some provision should obviously be made for refresher courses in analytical chemistry of varying scope, arranged primarily, but not necessarily solely, for the benefit of teachers. It is out of the question for Britain to regress, in the next few years, to the pre-war condition of being almost entirely dependent on Central Europe for such a prime necessity.

In conclusion, it may be claimed that a subject which is regarded by 50 per cent of the more important teaching institutions of the British Isles as worth teaching cannot in future be considered to be beneath the notice of the chemist in general.

It is impossible to thank personally all those teachers who took pains to fill up the questionnaire, and to supply valuable further information. Grateful acknowledgment of their help is therefore made here.

NEW BASIC CONCEPTS IN ELECTROCARDIOGRAPHY: THE VENTRICULAR GRADIENT

By DR. W. F. BERG*

CLINICAL, anatomical and experimental researc have all collaborated to make electrocardi graphy indispensable for the clinician. The natu and origin of the various irregularities of the hea rhythm can be diagnosed with accuracy. Since che leads have been introduced, one can get detaile diagnoses of heart muscle lesions, such as result fro an occlusion of the arteries supplying the hea muscle. Similarly, we are able to locate lesions with the specific nervous system of the heart known the bundle of His and its branches. It is even possib to diagnose toxic changes so small as to escape th methods of the pathologist. An important advan has more recently been achieved by the introducti of a new basic concept by the American worker F. N. Wilson[1] and his school. This has found almo immediate practical application.

In the state of rest the heart, in common with a muscles, consists of polarized cells: the insides of th cells carry electric charges which are neutralize by charges of opposite sign surrounding the cell The regular excitation and relaxation causes rhythmic sequence of waves of electric depolarizatio and repolarization to pass through the heart muscl Thus, at any one moment potential differences a set up between two points of the body; these ca be measured by any instrument which is sufficient sensitive. At any one instant the heart may likened to an electric battery, the poles of which a inserted into a conducting medium, the body; suc an arrangement is characterized by the direction a line pointing, say, from the negative to the positi pole, and by the strength of the poles. Thus th electric excitation of the heart muscle is best describe by an arrow possessing both a direction and a length this arrow is known as the instantaneous electric ax or heart vector. In order to determine this vect the following assumptions are commonly made.

In the standard procedure the current produce by the heart is recorded by an instrument of sho period such as a string galvanometer or cathode ra tube, which is connected in turn to two out of thr points: the left arm (*L.A.*), the right arm (*R.A* and the left leg (*L.L.*). Electrically the heart is co sidered to lie in the centre of an equilateral triangl which is large compared with the dimensions of th heart and which is named after Einthoven. Recor obtained simultaneously in two 'leads', say betwe the left and right arms, and the left arm and l enable the instantaneous heart vector to be dete mined by the construction indicated in Fig. 1. Th method is based on the consideration that th deflexion of the instrument in one lead is proportion to the projection of the heart voltage on to a straig line connecting the end points of that lead. Th the deflexion in each lead at any one instant is th component of the vector in the direction of the lea line as marked inside the triangle. Verticals a erected at the end point of each component on a lea line. A line drawn from the centre of the triangle the point where the verticals from two componen cross constitutes the instantaneous vector. If d flexions are obtained in three leads simultaneousl

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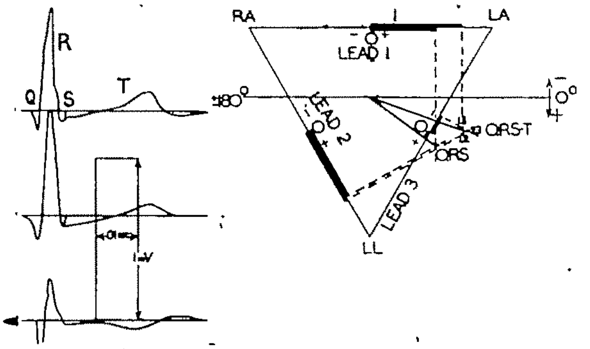

Fig. 1. PRINCIPLE OF THE HEART AXIS DETERMINATION.

(1), (2) and (3) are records obtained in the three leads. The figures in the table are the areas under the various parts of the records

	Lead 1	Lead 2	Lead 3	
	− 3 2	− 6·5	− 7·0	Calibration
	+37·5	+48 0	+10 5	
	− 2·5	− 1 5	0·0	0·1 mV. sec.=248
	− 5·0	−10·5	−16·0	1 μV. sec.=2 48
	+19·5	+12·5	+ 3·0	
	− 3·5			
RS	+31·8	+35·0	+ 3·5	
RS—T	+42·8	+37·0	− 9·5	Resultant
RS/2·48	+12·6	+14·1	+ 1·4	87° 15·5 μV. sec.
RS—T/2·48	+17·2	+14·9	− 8·8	20° 18 9 μV. sec.

hree end-points are obtained for the vector; these points should coincide if the Einthoven condition is fulfilled. The heart vector so determined constitutes he projection of the vector in space on to the plane determined by the three lead points[2].

Displacements of the heart as well as pathological changes influence the directions and the lengths of the heart vectors, and considerable variations are found. A certain degree of order has been introduced by the new concept due to Wilson[1] and his collaborators, and termed by them the 'ventricular gradient' (*G*); this means the average electrical activity during the excitation and contraction of the heart chambers, the averaging process being carried out over time, direction and length of the instantaneous vectors. Whereas the length of the instantaneous vectors is measured, say, in micro-volts, the dimensions of the average vector is in micro-volt seconds. Average vectors may be obtained for any part of the heart-cycle which can be recognized with certainty in each lead. Thus an average *QRS* vector is sometimes utilized[3], these letters referring to the first peak part of each record (Fig. 1).

The average vectors are obtained as follows Fig. 1). The areas under the different parts of the electrocardiogram *Q*, *R*, *S* and *T* are tabulated and added to give the total areas of *QRS* and *QRS-T* = *G*). These totals, standardized by dividing them by the area corresponding to 1 μV. sec., constitute the omponents of the average vectors along the sides of he Einthoven Triangle and are here marked by heavy lines, inside the triangle for *QRS*, and outside he triangle for *QRS-T*. The resultant vectors are shown and their length and direction can be read from the diagram.

The ventricular gradient is a concept of fundamental importance in the physiology of muscle action-currents. Depolarization and repolarization f the cells in the muscle are brought about most probably by movements of the same ions across cell membranes and back again. In a homogeneous muscle fibre the total electric activity due to depolarization must be equal and opposite to that rought about by the repolarization. This is true wherever the place of the original stimulation may be, since the waves of excitation and relaxation merely follow one another with opposite signs. If now the fibre considered is not homogeneous, but for example the systole—the state of contraction before relaxation sets in—lasts longer in one part of the fibre than in another, the total electric activities of excitation and relaxation may no longer be equal and opposite: the fibre now exhibits a 'gradient' of average electric activity. Records obtained from three equidistant points of a surrounding conducting medium would allow this gradient to be determined. Again, the direction and length of the gradient is independent of the point and method of stimulation of the fibre. This conclusion was beautifully confirmed by Wilson *et al.*[1] on a dog's heart. They cut the fibres along which excitation is normally conducted, so that excitation had to spread through the mass of the heart muscle. This altered completely the character of the electrocardiogram, but the gradient was not affected. Thus, "the ventricular gradient is the fundamental quantity in electrocardiography"[3]; generally speaking, it points from the part of the heart where systole is longest to where it is shortest.

A very thorough study of the ventricular gradient and the mean *QRS* vector has been carried out by Ashman and Byer and collaborators[3] on more than five hundred persons whose hearts were considered from clinical investigations to be normal. This large amount of material allowed the different factors influencing the mean vectors to be investigated. The average value for the gradient *G* is 52 μV. sec., for the *QRS* vector 25 μV. sec., being slightly smaller for women than for men. There is a distinct correlation between the size of the *QRS* and the *G* vectors: *G* tends to be about twice *QRS*, although many other factors influence the relationship in any one particular instance. The value of *G* decreases with increasing heart-rate *H*, the average over a large number of persons following a straight-line relationship which may be expressed as $G = 92 - 0{\cdot}5\,H$. Acceleration of the heart-rate by amyl nitrite or by exercise causes a change corresponding to this relationship, but a change from the recumbent to the supine position causes *G* to decrease very much more than corresponds to the resulting acceleration of the heart. This variation of *G* with posture is probably connected with a displacement of the heart, which tends to assume a more vertical position in the upright body.

A great deal of consideration was given to data which would allow the position in space of the *QRS* and *G* vectors to be derived from their projection on to the frontal plane as determined from the records. The assumption on which these considerations were based was that in the various normal hearts investigated, the *QRS* and the *G* vectors in space were identical with respect to length and relative position to one another and to the heart itself, and that the differences in length and direction of these vectors as projected on to the frontal plane were due to variations in the position of the heart in the body. Various indications as to the position of the heart were utilized, such as X-ray radiographs and relationships already established between the appearance of the *QRS* complex and a rotation of the heart around its longitudinal axis. The problem is very similar to that known to X-ray crystallographers: many data are available, but it is impossible to derive the configuration directly from these data. A shrewd guess guided by these data had to be made. The longi-

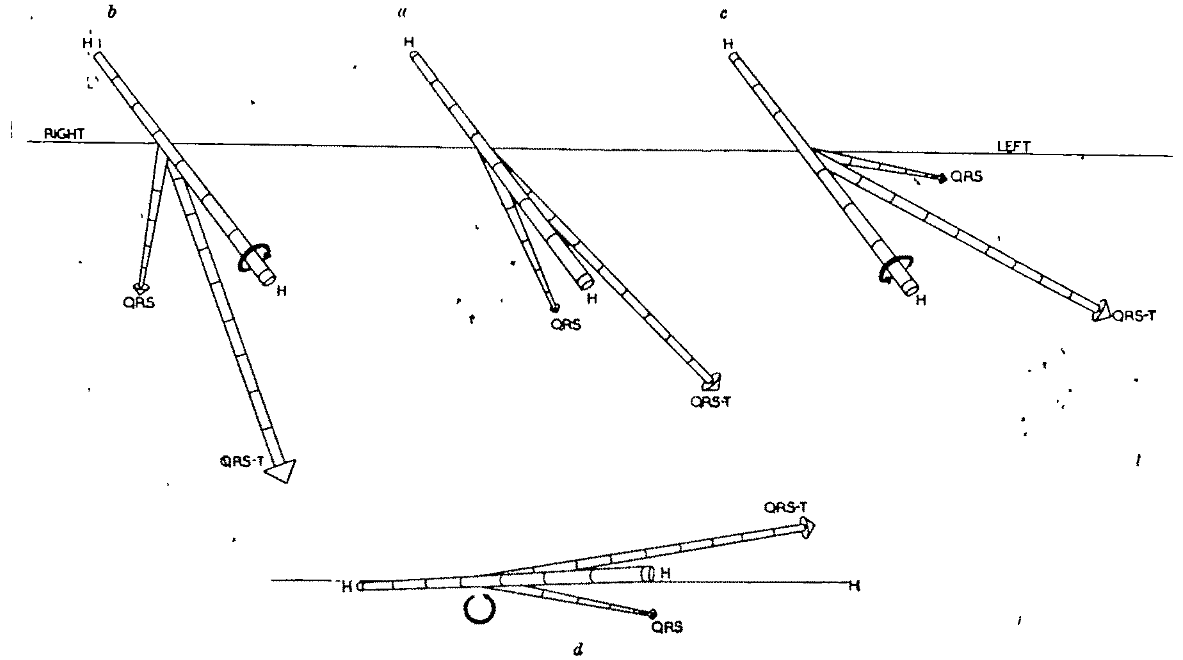

FIG. 2. VARIOUS POSITIONS OF THE HEART, CHARACTERIZED BY ITS LONGITUDINAL AXIS H—H AND THE RESULTING POSITIONS OF THE TWO AVERAGE VECTORS AS PROJECTED ON TO THE FRONTAL PLANE.

(*a*) is a heart in a normal position, (*b*) rotated clockwise around the longitudinal axis, (*c*) rotated around the same axis anti-clockwise. (*d*) is the heart as shown in (*a*) rotated around an antero-posterior axis as a result of pneumo-peritoneum.

tudinal axis of the heart, normally pointing slightly forward and to the left, the gradient and the *QRS* vector lie nearly in one plane. The gradient lies backwards from the longitudinal axis forming an angle of 60°, and *QRS* lies back still farther, making an angle of 90° with the axis. The length of the gradient is 92 μV. sec., that of *QRS* 44 μV. sec. A model of the heart with these vectors attached was projected by light on to a sheet of paper representing the frontal plane, and thus the various relationships between the measured values for length and position of the vectors could be checked up. Very good agreement was obtained between the directions of the vectors and their length as determined in the frontal plane. Typical results are indicated in Fig. 2. Here (*a*) indicates a typical normal heart, in which the anatomical heart axis is indicated by *HH*. The most common variation in human hearts is a rotation about the anatomical axis; where this is clockwise, as viewed from the apex towards the base, *QRS* appears to the right of *G* (Fig. 2*b*); where it is anti-clockwise, *QRS* lies to the left of *G* (Fig. 2*c*). Master[4] has published a thorough study of the correlation between the shape of the heart silhouette and the electro-cardiogram. Ashman and Byer[3] have evaluated his electro-cardiograms by vector analysis and added cases of their own. On the whole, the agreement is astonishingly good, and the model put forward by these authors to represent the relative positions of the vectors with respect to the heart would appear to be generally valid for a normal human heart.

Acceptance of this model thus provides a means for studying displacements of the heart using electro-cardiographic records. This method is all the more valuable where the displacement is so large that an investigation of the heart silhouette ceases to be a reliable guide. This difficulty arose in the course of an investigation by Benatt and myself[5] on the electrocardiogram in pneumo-peritoneum. This treatmen which was introduced into Great Britain by Cliffor Jones and MacDonald[6], is now applied widely in th treatment of tuberculosis of the lung, and consists i the induction of a litre or more of air into th abdominal cavity just below the diaphragm. A co siderable rise of the diaphragm then displaces th heart, which often becomes quite unrecognizable i the X-ray silhouette. The electrocardiogram was ver similar to that obtained with severe heart musc damage, but in the absence of any clinical symptom and since the pattern was completely reversible, was concluded that the new pattern was due to mere displacement of the heart. Vector analysis wa applied and both *QRS* and *G* vectors were found t deviate very strongly to the left, as indicated i Fig. 2*d*. The heart therefore must carry out a simil rotation around an antero-posterior axis, togeth with less important movements the description o which would take up too much space here.

Thus the new concepts of average electric hea vectors, and in particular of the ventricular gradien are beginning to play an important part in electr cardiography. After the fundamental groundwo has been done, applications to clinical work are no forthcoming. In his latest paper Ashman[7] discuss one of the most important signs of heart disease i the electrocardiogram, the so-called deviation of th *S-T* segment from the zero line, in relation to th magnitudes of the *QRS* and *G* vectors. More an interesting work is bound to follow from this line o thought.

In conclusion, a word regarding the organizatio of this research may not be out of place. It is n accident that all the research summarized above the result of team-work, and that the team include a physiologist or even a physicist. Work in th border region between medicine, physiology an physics usually requires collaboration. Research o his nature is a fine example of what the late Sir Thomas Lewis, the master pioneer in electrocardioraphy, has termed 'clinical science'. "The boundaries between individual sciences may not be mainained without hindering progress; overlaps between Clinical Science, pathology and physiology are vital o medical science as a whole; they bind together hree activities which in process of time have grown too far apart from one another"[8].

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REPEATING COMPASSES

By W. E. MAY

FROM time to time paragraphs appear in the Press on the subject of compasses in aircraft. They usually take the form of a complaint of the inaccuracy of magnetic compasses in general, followed by praise of some invention which is said to surmount all difficulties. The new instrument is often improperly described as a 'gyro-compass'. It is not the purpose of this article to advertise or condemn any of these inventions, but to enable the reader to see in proper perspective the claims which they contain.

For nearly a century, inventors have striven to perfect a repeating magnetic compass, that is to say, a compass the indications of which are automatically ransmitted to a point or points at some distance. Many methods of obtaining signals from an ordinary magnetic compass in order to work a repeater system have been tried. Among these may be mentioned he forms using selenium cells, intermittent positive contact between contact on the card and in the bowl, or a Wheatstone bridge principle using electric currents passed through the liquid in the bowl. All need some form of signal amplification which may be obtained by the use of valves or relays.

When we talk of a magnetic compass we are apt o think only of the ordinary instrument containing a needle which aligns itself with the direction of the lines of magnetic force; but there is a second type which particularly lends itself to the provision of a epeating system. That is the earth inductor or otating inductor compass, which depends on the principle that if an armature, similar to that of a mall electric motor, is rotated about a vertical axis in the earth's magnetic field, it generates a current. This current can be tapped off in the ordinary way by means of a commutator and brushes, the strength and direction of the current in the external circuit being determined by the orientation of the brushes elative to magnetic north. There will be a relative brush position where no current flows in the external circuit.

Thus by various means both the needle and earth inductor types of repeating compass give a signal as oon as the bowl (or other follow-up unit such as the brush carriage) is out of step with the directional element. This signal can be made use of in two ways. In the simple form the bowl is turned by means of a Bowden wire to the position corresponding to the course desired. When the aircraft is off her course, a simple indicator shows the pilot which way to steer to get back.

In the more ambitious arrangement, the directional signal is used to control a follow-up motor which drives the bowl round until the position of 'no signal' is reached. At the same time it drives a step-by-step transmitter through gearing, and this transmitter drives the repeaters electrically so that they indicate the orientation of the bowl and consequently the course of the aircraft.

Another type of repeating compass may be styled the static inductor type. In this type an alternating electric current is passed through a coil wound on an iron alloy core bent into a triangle or other shape. This core is fixed in the aircraft with its plane horizontal. According to the course of the aircraft, the various sides of the core will be magnetized in a greater or less degree by the magnetism of the earth. The fact that the sides thus become magnets of differing strengths upsets the balance of the alternating currents in the parts of the coil wound round them, thereby causing varying currents to flow in wires which are tapped off the coil at intervals. These tappings are led to coils in the repeater where they set up a magnetic field. A magnetic needle lines itself up with this field and thus indicates the course of the aircraft.

A combination of the needle and static inductor type of compass is also sometimes used. This is similar to the static inductor type, but contains in addition an ordinary compass needle of rather high magnetic moment. The needle points to magnetic north and also serves to induce magnetism in the core of the inductor.

A type of compass which is often referred to nowadays is the gyro-compass. This compass depends on the fact that a perfectly balanced gyroscope will always tend to keep its axis pointing in a fixed direction in space. This of itself would be of little value as a direction indicator, since the earth's rotation will produce a continuous variation in the direction of the axis relative to the meridian. The gyroscope can, however, be made to act as a compass by the introduction of some form of control, so that this fixed direction in space is amended until the axis is horizontal and pointing along the meridian. In the true gyro-compass, this is effected by using the rotation of the earth to harness the force of gravity to the gyroscope.

The arrangement is perfectly satisfactory in a ship of moderate size, but in aircraft the higher speeds and greater manœuvrability produce accelerations introducing a varying false vertical and upsetting the control. All attempts to use gyro-compasses in aircraft have consequently been failures.

The gyroscope, as distinct from the gyro-compass, has, however, a use in aircraft. We have not been able to produce a gyroscope so well made that it will give a perfect performance with its axis maintaining a fixed direction in space indefinitely, but we can make one which will maintain its direction for a matter of minutes. It will be appreciated that having no gravity control, this gyroscope will be unaffected by the movement of the aircraft. If now we link any form of repeating magnetic compass to this gyroscope, so that the latter is controlled by the former, the gyroscope will tend to line itself up with the magnetic compass; but as its rate of precession is much less than the rate of oscillation of the compass, it will actually line itself up to the mean direction of that instrument. In this way, by using a magnetic compass to control a gyroscope and the gyroscope to control repeaters we get a combination, known as a 'gyro-magnetic compass', which smoothes out most of the erratic oscillation of the ordinary compass.

Another application of the gyroscope is sometimes used. In those static inductor compasses where the core is magnetized by a compass needle, it is convenient to use a double-axis needle, that is, one which is mounted on a vertical axis instead of being free to dip as in the ordinary compass. This method of mounting introduces difficulties, because if accelerations cause the axle to leave the vertical, the vertical force of the earth pulls down on the north end of the needle, thereby deflecting it from north and causing an error. By introducing a gyroscope into the instrument it is possible to use the gyroscope to stabilize it so that the axle of the needle will always remain truly vertical.

When speaking of gyro-magnetic compasses it must be clearly understood that they are fundamentally magnetic compasses and not gyro-compasses. Although they have the advantage of smoothing out oscillations, they still point to the magnetic and not to the true north. The master compass must be fitted in a position as remote as possible from magnetic disturbance. The aircraft must be 'swung' to adjust the compass in the ordinary way, and rather more than ordinary care is required to do this effectively. Finally, a deviation table must be obtained and the deviations applied to *all* repeaters when using them.

The statement that the gyro-magnetic compass indicates the magnetic rather than the true north must be qualified. In some systems a variation-setting corrector or other device is provided. This is a link in the repeater system which enables the repeaters to be put out of step with the master in a convenient manner. If the variation is kept set on this device, the repeaters will show a heading differing from true by the deviation. If the variation plus deviation is kept set, the repeaters can be made to indicate true north, but it will be noted that this does not mean that the swinging of the aircraft for compass adjustment can be dispensed with.

We can now summarize the several points to be considered when judging the relative advantages of the various systems. They are : (1) A needle compass is liable to be affected by accelerations and movements of the aircraft, that is, by swirl error, northerly turning error, etc. (2) All types of magnetic compasses, whether they be needle or inductor or a combination of both, indicate the direction of the magnetic field at the compass position, and not necessarily the magnetic meridian. It follows that they all have deviations which must be allowed for or corrected. (3) Repeating compasses can be placed in better positions from the magnetic point of view than those positions from which the aircraft is controlled. (4) In repeaters other than those driven on the step-by-step principle, the needle is apt to be made to oscillate by shocks and accelerations. The repeaters, however, are self-synchronous so do not need lining up when the compass is switched on. (5) Inductor compasses are less sensitive than needle compasses. (6) Gravity controlled gyro-compasses cannot be used in aircraft. (7) Gyro-magnetic compasses require adjusting like any other magnetic compasses, but smooth out swirl and northerly turning errors. (8) The introduction of a gyro introduces an additional electrical complication.

OBITUARIES

Mr. C. S. Middlemiss, C.I.E., F.R.S.

WITH the death on June 11, 1945, at Tunbridg Wells, at the age of eighty-five, of Mr. Charle Stewart Middlemiss, Indian geology has lost its doyen one who will long be regarded as one of the grea figures of Indian geology. Middlemiss was the so of Robert Middlemiss of Hull, where he was bor on November 22, 1859. He was educated at Caisto and St. John's College, Cambridge, taking his B.A degree in 1881. He joined the Geological Surve of India on September 20, 1883, when H. B. Medlicott was still head of the Department.

During his service, Middlemiss did field work i the Himalaya, the Salt Range, and Hazara, all i north-western India ; in Coimbatore, Salem and th Vizagapatan Hill Tracts in the Madras Presidency in the Southern Shan States and Karenni in Burma in Central India, Rajputana and North Bomba (Idar) ; and finally in Kashmir. He also investigate the earthquakes of Bengal (1885), Kangra (1905) and Calcutta (1906). During spells at headquarter he was curator of the Geological Museum (1898–99) and in charge of the headquarters office (1907–8) He was promoted deputy superintendent in 188 and superintendent in 1895. He officiated as directo for two periods, during 1914–15 and in 1916. In 1903 he paid a visit to Ceylon on deputation.

Middlemiss should have retired from the Geological Survey of India on reaching the age of fifty five in 1914, but on account of the War his servic was extended so that he did not leave the Departmen until April 1, 1917, after being gazetted C.I.E. i 1916. As a result of this extension, Middlemis holds the record for length of service in the Geological Survey, amounting to 33 years 6 months an 11 days (beating Medlicott by five months and eigh days). Having created this record, Middlemiss the entered the service of the Maharaja of Kashmir, with the title of superintendent, Mineral Survey, Jamm and Kashmir, from which he did not retire until hi seventy-first year in 1930, after a total service i India of more than forty-six years.

Of other scientific activities, we may record tha Middlemiss became an ordinary and life member o the Asiatic Society of Bengal in 1884, and a fellow in 1912, being at the time of his death the senio member of the Society by four years and also th senior fellow. He became a fellow of the Geologica Society of London in 1900, and was awarded th Lyell Medal in 1914. Middlemiss was elected fellow of the Royal Society in 1921. He was presiden of the Geological Section of the Fourth India Science Congress at Bangalore in 1917 and presiden of the Ninth Indian Science Congress at Madras i 1922. He was also president of the Mining an Geological Institute of India in 1928.

Middlemiss married Martha Frances Wheeler daughter of Major-General Wheeler, of the Benga Staff Corps. They had five sons and one daughter of whom two sons died early in India, and two son lost their lives in the War of 1914–18, in Gallipol and France respectively. On retiring from India Middlemiss settled down at Crowborough in Sussex where he became a centre of local activities. Mr Middlemiss died in 1931.

Middlemiss, as first known to my contemporarie and me, was already in the forties—partially bal with an aureole of grey hair, bright blue eyes, pleasan riendly expression, very sturdily built, and above medium height. He had an extraordinarily youthful mind and was always ready for fun.

This youthful mind was also an experimental one, o that Middlemiss was willing to try anything, and specially anything new. He developed thus a multitude of interests outside geology, the principal f which were perhaps music and sketching in water colours; but he was also interested in verse, n Esperanto, in chess, rowing and lawn tennis. In Esperanto he kept the Calcutta Esperanto Society live, acting as its honorary secretary for some years. n music he devised a new system of notation, not eing satisfied with the existing system. To his unior officers he was very helpful, both in the field nd at headquarters, and because of his friendly ature he was always accessible.

Middlemiss was essentially a field man, believing n the direct appeal to the rocks by means of the ammer. He was able to illustrate his notes with is skilful pencil and brush, often making use also f the *camera lucida* in order to ensure correct outnes in panoramic views; and as in addition he had n accurate but eloquent pen, he has been able to resent the results of his studies in a large number f papers, four of which rank as memoirs, almost all f which contain inspired passages, and all of which mply repay study.

His field work may be divided into three spells, he first of some ten years in north-western India Garhwal, Kumaon, the Salt Range, and Hazara), he second of some twenty-two years in Peninsular ndia (with many interruptions), and the third of ome twenty-two years in Kashmir and Jammu, he latter overlapping his middle period.

Middlemiss's most important work was probably hat done in his first spell, represented by several hort papers and two fine memoirs. In the earlier memoir (*Mem. Geol. Surv. India*, **24**, pt. 2; 1890) he ublished his classic studies of the Siwalik zones of he Sub-Himalaya, and discussed the origin of the Himalaya ranges, adopting Osmond Fisher's views nd showing himself to be an isostasist before the ord 'isostasy' had reached him. In his second memoir (*Mem. Geol. Surv. India*, **26**; 1896), Middlemiss describes the geology of four parallel zones of isturbance or elongated blocks of formations, elonging to the Hindu Kush system of ranges triking north-east, contemporaneous in age with the Himalayan system of ranges striking north-west. s in Garhwal and Kumaon, he shows that as one moves outwards from mountain to plains across these ones each successive outer zone is separated from he preceding inner zone by a major thrust-plane, o that the inner older zone overrides the younger uter zone.

In his brief spell in the Salt Range, Middlemiss arted the controversy not yet ended, as the recent olumns of *Nature* have shown, concerning the age f the Saline series. For Middlemiss cast doubt upon he view that the Salt Marl was Cambrian or pre-Cambrian, as seemed likely in view of the position f this series at the foot of the Salt Range scarp. his he did by demonstrating that everywhere the alt Marl showed discordant relations, often of an pparently intrusive nature, to the physically overing rocks (*Rec. Geol. Surv. India*, **24**, 19; 1891), and explain these phenomena he propounds his hypoesis of the quasi-intrusive nature of the Salt arl (in late Tertiary times).

In his latest contribution, written in his eighty-fifth year (see the symposium arranged by Prof. B. Sahni, *Proc. Nat. Acad. Sci. India*, **14**, Sect. B, p. 267; 1944), Middlemiss claims that his theory of the quasi-intrusive nature of the Salt Marl is in harmony with modern requirements "even though acceptance of the possible guess . . . that an igneous magma may have been ultimately responsible, is too much to expect".

We must now refer to Middlemiss's middle period of work, that in Peninsular India. Here his earlier work was on the magnesite and corundum deposits of the Salem and Coimbatore districts, followed by mapping in the Vizagapatan Hill Tracts, a country of longitudinal strips of acid gneisses, of the charnockite series, and of the khondalite series. Here he found interesting hybrid rocks containing sapphirine (until then only known in Greenland), spinel, cordierite and sillimanite, formed at the intrusive contact of an ultra-basic member of the charnockite series with the sedimentary khondalite series (see *Rec. Geol. Surv. India*, **31**, 38; 1904; and **36**, 1; 1906). He also found nepheline-syenites (miaskite) similar to the rocks of the Urals and Sivamalai in southern India. Later he held charge of the Central India and Bombay party of the Geological Survey of India and produced a detailed memoir on the geology of Idar State (*Mem. Geol. Surv. India*, **44**, pt. 1; 1921).

We come now to Middlemiss's third period—Kashmir with Jammu. Here his first task was to study a recently discovered occurrence of Gondwana plants (*Gangamopteris*) in their stratigraphical relationships. In crossing the Pir Panjal Range by the Golabgarh Pass, he found a supremely important section, with not only *Gangamopteris* but also *Glossopteris* beds overlain in due course by a marine limestone containing *Protoretepora ampla* Lonsd. Middlemiss had thereby succeeded in correlating the great freshwater Gondwana formation of Peninsular India with the richly fossiliferous marine sedimentary systems of the Himalayan area—two widely distinct geological provinces not hitherto found in juxtaposition. The age of the lowest Gondwana beds was shown to be Permo-Carboniferous (Artinskian). His work in Kashmir did not then cease, for he had found incidentally that the previous survey of Kashmir had been made on too small a scale, so that the whole of the geology needed revision. Consequently he set out to make detailed surveys of selected areas and thereby laid successfully the foundations of a new geology of Kashmir, foundations upon which H. S. Bion began to build until his premature death in 1915; foundations upon which Mr. D. N. Wadia built so effectively later that he was awarded by the Geological Society of London in 1943 the same medal as had been bestowed on Middlemiss in 1914, the Lyell Medal.

On joining the Kashmir service in 1917, Middlemiss had to concentrate upon the study of the mineral resources of Jammu and Kashmir. This he did to such effect that he produced no less than ten reports published as *Reports of the Mineral Survey of Jammu and Kashmir*, following two papers published in the *Records of the Geological Survey of India*. Two of these reports deserve mention here. One is his report on the "Bauxite Deposits of Jammu Province" (*Min. Surv. Rep.*, 1; 1928). These deposits are found in association with the Riasi dome of the Great Limestone. The bauxite is of unusual character, being a monohydrate instead of a trihydrate. It is accordingly unusually high in alumina (70–80 per cent instead of 50–60 per cent usual in the lateritic bauxites of the Peninsula); it is also unusually low in iron oxide and of high density and hardness. The quantity is considerable, and one day it will be used, perhaps, with the aid of electric power generated from the high-grade Nummulitic coals that overlie it stratigraphically, or from a projected hydro-electric installation on the Chinat River.

The second paper to be mentioned is on the "Possible Occurrence of Petroleum in Jammu Province" (*Rec. Geol. Surv. India*, 49, 191; 1919), in which he demonstrates the existence of a structure (the Nar-Budhan dome) suitable for the storage of oil, and existing in rocks identical with those of the existing oilfields near Rawalpindi in the Punjab. This dome has not yet been tested. During the course of this latter survey, Middlemiss succeeded in measuring the angle of the thrust-plane or reversed fault (the Great Boundary Fault of the Himalaya) between the Siwalik and Murree zones of formations near Kotli. The angle was found to be only 12°–15°, a much lower figure than had been previously assumed by all who constructed geological sections across the Himalaya, but an angle in accordance with the modern views of *nappe* structure.

This notice is already too long to permit more than a passing reference to Middlemiss's important memoir on "The Kangra Earthquake of April 4, 1906" (*Mem. Geol. Surv. India*, 38, 1; 1910). In this disastrous earthquake more than 20,000 persons lost their lives. Middlemiss shows that there were two epicentral tracts or foci, a principal one in the Kangra Valley of intensity 10 on the Rossi-Forel scale, and a subordinate one in the Dehra Dun of intensity 8 These two foci were situated at the two places where the Sub-Himalayan zone of Tertiary formations embays in a north-easterly direction into the Lower Himalayan zone, and separated by the bulge o bastion of Lower Himalayan formations upon which Simla stands. The earthquake represents, in Middlemiss's view, an attempt to reduce these embayments

L. L. FERMOR.

WE regret to announce the following deaths:

Prof. F. Akerblom, formerly professor of meteorology in the University of Uppsala, on July 24.

Mr. C. E. Fairburn, chief mechanical and electrical engineer of the London, Midland and Scottish Railway, on October 12, aged fifty-eight.

Mr. G. S. Fawcett, managing director of The Tintometer, Ltd., on November 8.

Dr. R. D. Gillespie, the well-known psychiatrist, on October 30, aged forty-eight.

Prof. V. E. Henderson, professor of pharmacology in the University of Toronto, on August 6, aged sixty-eight.

Dr. H. K. Sen, professor of applied chemistry in the University College of Science, Calcutta, during 1920–36, director of the Lac Research Institute Namkum, during 1936–44, lately director of industries Bihar, on June 3, aged fifty-seven.

Prof. C. E. Wright, professor of gunnery and mathematics in the Military College of Science, Woolwich, on October 30, aged fifty-nine.

NEWS and VIEWS

Royal Society Medal Awards

THE King has approved the recommendations made by the Council of the Royal Society for the award of the two Royal Medals for the current year as follows: Prof. J. D. Bernal, professor of physics at Birkbeck College, University of London, for his work on the structure of proteins and other substances by X-ray methods, and for the solution of many other problems requiring a physical approach; Dr. E. J. Salisbury, director of the Royal Botanic Gardens, Kew, for his notable contributions to plant ecology and to the study of the British flora generally.

The following awards of medals have been made by the President and Council of the Royal Society: Copley Medal to Dr. O. T. Avery, emeritus member of the Rockefeller Institute, New York, for his success in introducing chemical methods in the study of immunity against infective diseases; Davy Medal to Prof. Roger Adams, head of the Department of Chemistry, University of Illinois, for his extensive researches in the field of organic chemistry and his recent work in the alkaloid field; Hughes Medal to Prof. B. F. J. Schonland, Carnegie–Price professor of geophysics and director of the Bernard Price Institute of Geophysics in the University of the Witwatersrand, for his distinguished work on atmospheric electricity and of his other physical researches.

Paludrine: a New Anti-malarial Drug

PALUDRINE, or 4888 as it was first called, the new drug for malaria, which was announced at the annual meeting of the Liverpool School of Tropical Medicine on November 5, was discovered in the laboratories o I.C.I. at Blackley, Manchester. The chemical work was directed by Dr. F. H. S. Curd and Dr. F. L Rose, and the biological work by Dr. D. G. Davey The substance has two outstanding points of scientific interest. First, it marks a complete departure in chemical structure from the known antimalaria drugs; it is not a quinoline like quinine and pamaquin, and it is not an acridine like mepacrine—a account of it, together with its constitution, will b given in papers which will appear shortly in th *Annals of Tropical Medicine and Parasitology* Secondly, in avian malaria it has a powerful actio not only on the blood forms of the parasite, but als on the so-called exoerythrocytic forms. The latte are now known to occur in almost every type o avian malaria, and it is the working hypothesis o the I.C.I. group of workers, as it is of some others that these forms also exist in human malaria althoug they have never been demonstrated microscopically

According to this hypothesis, the two major problems of malarial chemotherapy, namely, complet protection against benign tertian malaria by th prophylactic use of drugs, and a radical cur of benign tertian malaria, will be solved b the discovery of drugs with an action on ex erythrocytic forms. Paludrine has such an actio on these forms in avian malaria, and there is som evidence, admittedly very incomplete, that unlik quinine and mepacrine, it acts upon the as yet un demonstrated exoerythrocytic forms of *Plasmodiu vivax* and consequently that it gives a better pr tective action. The investigation is still proceedin

The workers at the Liverpool School of Tropical Medicine, under the direction of Prof. B. G. Maegraith and Dr. A. R. D. Adams, R.A.M.C. officers at Colchester and Woolwich, and Major-General Covell in ndia, are studying the effect of paludrine on the relapse-rate of benign tertian malaria, while in Australia a team of research workers in the Australian Army, led by Brigadier N. H. Fairley, is making an intensive study of its prophylactic action. The work of Brigadier Fairley is noteworthy for the great use which is made of volunteers, and the consequent igorous control which is kept over all aspects of the experiments.

The full significance of all the work, which has been done under the auspices of the Medical Research Council, has still to be assessed, but paludrine appears to be a notable advance in the chemotherapy of malaria. The Liverpool workers, who were the first to treat human cases with the new substance, are impressed by the latitude allowed the clinician in treatment, for doses fifteen or twenty times the size of those necessary to control clinical symptoms can be given with impunity, while Brigadier Fairley is mpressed by the remarkable suppressive action which the drug possesses. Unlike mepacrine, paludrine is not coloured and does not stain the skin. It is also a simpler substance, chemically, and it should be easier to manufacture. The two qualities, potential cheapness and freedom from undesirable effects at therapeutic doses, are themselves sufficient to make paludrine an important new drug.

Government Support for Research Associations in Britain

Announcing in an address to the Conference of Industrial Research Associations on November 6 that grants to such associations would form a permanent part of the activities of the Department of Scientific and Industrial Research, Mr. Herbert Morrison, Lord President of the Council, declared that we need esearch workers to-day as much as in 1940, and that he Government will do everything possible to encourage British industry to use scientific research. It is essential that some of the money gained to ndustry by relief from taxation in the new Budget should be invested in research. Large concerns, he hoped, would establish or extend their own research departments, but smaller concerns should give their full support to existing research associations, for no ingle section of industry can do without this essential scientific partnership and remain virile. Moreover, Government support of industrial research must be backed by readiness to use its results, and firms which cannot maintain fully equipped research taffs of their own should employ at least some trained scientific workers who can co-operate with he appropriate research association and help in the interpretation and application of its work.

Expenditure on research should be regarded as an essential cost, and dealing with the finance of research associations, Mr. Morrison said that with larger incomes the research associations would be able to carry out more of the expensive development work. The Government has therefore decided that in suitable ases it will make single grants to finance capital expenditure for such special purposes as buildings and re-equipment, the purchase of particularly expensive apparatus or the provision of semi-scale plant. Until research association attains an appropriate scale, the present system of a block grant and an additional grant will continue. Eventually, the additional grant will cease, but a new block grant will be made, to continue indefinitely so long as the Department of Scientific and Industrial Research is satisfied with the activities of the association. The associations, Mr. Morrison said, can rely on the Government to proceed as rapidly as possible with the release and training of promising research workers, and all possible assistance will be given for rebuilding or extending laboratories. Sir Edward Appleton, referring to the importance of first-class research workers, pointed out that a monastic life is not stimulating to the young scientific worker, and there should be the closest contact between the research associations themselves, and with the universities and other research establishments.

Air Speed Record by Jet Propelled Aircraft

Group Captain H. J. Wilson, R.A.F., piloting a Gloster Meteor aircraft powered with two Rolls Derwent gas turbine engines, regained the speed record for Great Britain on November 7, flying over a course in the Thames estuary off Herne Bay. The officially recognized speed, being the average of four flights over the course in opposite directions, was 606·2 miles an hour. Mr. Eric Greenwood, the chief test pilot of the Gloster Aircraft Co., also flew a similar course, on another machine of the same type, averaging 603 miles per hour. The previous speed record was held for Germany by Fritz Wendel. This was set up on April 27, 1939, when he flew a Messerschmidt Bs.109R monoplane at 469·2 miles per hour.

The development of the Gloster machine is the result of research and experiment principally by Air Commodore F. Whittle in conjunction with Messrs. Power Jets, Ltd. The final design and construction of the aircraft and the engine were the responsibility of the Gloster Aircraft Co. and Messrs. Rolls Royce respectively. The attainment of such speeds is due to developments that are perhaps less obvious than the actual result. The production of a gas turbine having a thrust at the jet that gives, at 600 m.p.h., a horse-power of from two to three times greater than anything reached by the conventional aero engine is the most important factor. The use of jet propulsion allows this power to be turned into useful thrust more certainly than the usual airscrew method of propulsion could have accomplished. The problems of control of the aircraft at speeds approaching the speed of sound were unique and have been overcome by the aircraft designer. The machine was designed for lower speeds with earlier and less powerful engines, and it is a tribute to his foresight that it has been able to stand up to the increased stresses with a minimum of local strengthening involving no radical redesigning. The actual record-breaking aircraft was a production type of the standard R.A.F. Meteor that is now in service, and has been used in operations both over Germany and for shooting down flying bombs over Great Britain. Special preparation of the machine and the development of the general flying technique for the attempt has been under the supervision of Group Captain Wilson at Manston Aerodrome.

International Council for the Exploration of the Sea

At a meeting held in Copenhagen during October 15–19, attended by delegates and experts from Great Britain, France, Norway, Denmark, Sweden, Finland, Holland and Iceland, the International Council for the Exploration of the Sea was formally reconstituted for a five-year period, as from July 22, 1945. Though the last five-year period ended in 1941, the Council was kept in being throughout the War thanks to the efforts of its president, Dr. Johan Hjort, aided by financial contributions from several Continental countries, including substantial additional subsidies from Denmark. At the recent meeting Dr. Hjort (Norway) was re-elected president, and the following four vice-presidents were appointed to constitute, with the president, the Bureau or Executive Committee: Mr. A. T. A. Dobson (Great Britain), Prof. Martin Knudsen (Denmark), Dr. K. A. Andersson (Sweden) and M. Pierre Tissier (France). Dr. H. Blegvad (Denmark) was appointed general secretary in succession to the late Capt. Nellemose, who fell a victim to the Nazis. The scientific work of the Council is organized by a number of area committees, which draw up co-operative programmes of research that are reviewed by the Consultative Committee. The great majority of these committees were re-established at the recent meeting and agreement reached as to the lines of work to be pursued for the ensuing year. Dr. E. S. Russell (Great Britain) was reappointed chairman of the Consultative Committee.

The Council, which was formally founded in 1902 and, through the courtesy of the Danish Government, has its headquarters near Copenhagen, has now survived two wars and has proved itself one of the most successful organizations set up to co-ordinate scientific research on an international basis. It concerns itself primarily with the investigation of fishery problems, together with the cognate problems of marine biology and hydrography. It has published a long series of scientific reports and valuable annual summaries of fishery statistics and hydrographical data. Its journal, suspended during the War, will, it is hoped, reappear early next year. The recent meeting was well attended, especially by Scandinavian members. The British delegates were Mr. A. T. A. Dobson and Mr. J. E. de Watteville, the fisheries secretaries for England and Scotland, respectively, and the British delegation included Sir John Edgell, lately hydrographer to the Navy.

Nicolas Lemery (1645–1715)

AMONG the students of medicine and pharmacy who did good work during what has been called "the dawn of scientific chemistry" was the Frenchman Nicolas Lemery, the tercentenary of whose birth falls on November 17. He was born at Rouen, and as a youth he spent some years with Glazer at the Jardin du Roi in Paris, but found his master much imbued with the dreams of the alchemists. Proceeding to the University of Montpelier, he spent three years studying medicine, pharmacy and natural history, and then after travelling through various parts of France took up his residence in Paris. By his lectures he gained a wide reputation which was much enhanced by the publication in 1675 of his "Cours de Chymie", which in eighty years went through thirteen editions and was translated into Latin, German, Italian, Spanish and English. Scarcely had he sprung into fame than, through being a Calvinist, he found himself threatened by persecution and, like many of his countrymen, fled to England. Embracing Catholicism, however, he was enabled to return to France and resume his lecturing, and in 1699 was elected a member of the Royal Academy of Sciences. Among his other writings were his "Pharmacopée universelle" and his "Traité universel des drogues simple", both published in 1697. "Chemistry," he said, "is a science of observation, it can only be based on what is palpable and demonstrative." Thom Thomson wrote of him that he was "The first Frenc man who completely stripped chemistry of i mysticism,' and presented it to the world in all i native simplicity". Lemery died in Paris on June 1 1715, leaving a son, Louis (1677–1743), who he important medical appointments in the Frenc capital and published several books.

Karel Vrba (1845–1922)

PROMINENT among men of science in Bohemi towards the end of last century was Karel Vrb Born at Klatovy in west Bohemia on November 1 1845, he studied science at Prague and graduate in 1868, first becoming assistant to the professor mineralogy, Dr. V. von Zepharovich, and later *doce* in petrography. Then he was appointed profess of mineralogy at Czernowitz in Bukovina, returnin to Prague in the same capacity in 1881 when t Czech University was reinstated. At this time the was a complete overhauling of the old collection minerals, to which Vrba constantly added more make it as complete and representative as possibl He gave the first detailed descriptions (sometimes long monographs) of twenty-nine minerals, most occurring locally though a few came from abroa including one from Bolivia. The accounts of stepha ite (1895) and the beryls of Pisek (1888) are regard as Czech classics in science.

For teaching purposes, Vrba constructed speci crystal models that were produced in tens of thousand and were used in all parts of the world, althou their origin was not always attributed to him. H was prominent in the movement that led to t foundation of the Czech Academy of Science in 189 Since 1869 there had been a Natural Science Clu in Prague, and Vrba attended the lectures and join in the biological and geological excursions. Neve theless there was a need for a more august body f the discussion and publication of original research The Academy soon became the leading Czech scie tific institution. Vrba retired in 1912 and liv through the First World War to see the early years the Czechoslovak Republic, though he was too infir to take an active part in the rapid expansion scientific activities that occurred after 1918. Besid other foreign connexions, he was an honorary memb of the Leningrad and Odessa scientific societies.

Announcements

THE following have been elected honorary membe of the Institution of Civil Engineers: Field Marsh the Hon. Sir Harold Alexander and Sir Edwa Appleton.

SIR LAWRENCE BRAGG is visiting Portugal und the auspices of the British Council to lecture "Some Problems of the Metallic State" and on matte connected with X-rays. He will lecture in Lisbo Oporto and probably also Coimbra.

SIR GEORGE STAPLEDON is to retire from the po of director of the Grassland Improvement Stati on December 31. Sir George undertook to organi and direct the work of the Station as a war-ti task, and now wishes to be relieved of these respo sibilities.

AN exhibition is being arranged at the Cur Museum, Alton, Hants, during January 11, 12 and 1 1946, to commemorate the bicentenary of Willi Curtis (1746–99), founder of *Curtis's Botanical Mag zine*, who was born at Alton.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Conditions for the Vernal Increase in the Phytoplankton and a Supposed Lag in the Process

In his recent discussion of the fertility of ocean waters, Harvey[1] mentions that "A phenomenon which seems to lack explanation is the time at which phytoplankton start to increase rapidly at the beginning of he year", for by mid-winter all the known nutrient salts have been regenerated and, in spite of the bright ight of spring, the steep increase in the phytoplankton, as shown by the decrease in phosphate, becomes apparent in the English Channel normally only between March and April, and even much later elsewhere. He mentions the well-known effect of turbulence in carrying the cells down into regions of ow illumination, and suggests that there are unrecognized factors controlling the inception of growth n some areas. Sverdrup[2] also states: "This conditioning of the water may well be a factor in the nitial outburst of phytoplankton growth when other conditions are optimum"; thus he also alludes to an unknown factor.

In 1923 I obtained decisive evidence that light alone is necessary for the full development of the phytoplankton up to complete exhaustion of the phosphate supply[3]. This was done by taking water from the surface of the English Channel about 15 km. out to sea on December 18, 1922, January 16, February 12 and March 8, 1923. These samples were exposed side by side in a south window from March 24 after storing in the dark. It took thirty days to exhaust the phosphate in the December sample, slightly less in the January one and only about five days for the February and March samples. The explanation offered was that the spring samples contained a larger number of cells. "In winter, however, he much smaller numbers present can apparently be doubled or quadrupled with but little effect upon the amount of phosphate as ascertained by analysis."

A culture of the diatom *Nitzschia closterium* W.Sm. showed that half a milligram of phosphorus produced 10^9 diatoms, so this number must be present per cubic metre before any diminution in phosphate can possibly be detected, as 0·5 mgm./m.³ is the limit of sensitivity. The lag in production follows as a mathematical necessity, since in winter the number of plankton cells is relatively much reduced. Using a north window culture of the diatom, it was ascertained that a fourfold increase required sixteen days, March 27–April 13. Thus one cell would, after eight uccessive doublings, become 256 and the process would require 64 days, and similarly for any other rate of increase.

Where vertical mixing is reduced one may find the spring outburst well under way even by February 21, as in the middle of the Channel in 1928; the surface water contained only 5 mgm./m.³ of phosphorus[4], though near the Eddystone and off Ushant there was more than double as much, as also in mid-Channel from 5 metres down. The stability f the water column is thus of fundamental importance, and as already shown[5] the thermal stability of sea water is much greater than that of fresh water, which has maximum density at 4° C. as against − 2° C. for sea water. For the same temperature difference, resistance to mixing increases as the temperature rises. Oceanographers appear to have overlooked these two factors.

Dr. Harvey kindly showed me his proofs in 1943 during my temporary return to Plymouth, and I regret that I did not then direct his attention to the early work. Dr. Harvey still considers that "there is a reasonable *suspicion* that something else besides light, turbulence and grazing plays a part".

W. R. G. Atkins.

Department of General Physiology,
Marine Biological Laboratory,
Plymouth.
Sept. 29.

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[1] Harvey, H. W., "Recent Advances in the Chemistry and Biology of Sea Water" (Cambridge, 1945).

[2] Sverdrup, H. U., Johnson, M. W., and Fleming, R. H., "The Oceans" (New York, 1942).

[3] Atkins, W. R. G., *J. Mar. Biol. Assoc.*, 13, 119 (1923).

[4] Poole, H. H., and Atkins, W. R. G, *J. Mar. Biol. Assoc.*, 16, 297 (1929).

[5] Atkins, W R. G., *J. Mar. Biol. Assoc.*, 13, 693 (1925); and *J. Conseil Internat. Expl. de la Mer*, 1, 99 (1926).

Energy of the Hg—C Bond and the Heat of Atomization of Carbon

It has not yet been possible to make a final choice, from spectroscopic and vapour pressure data, between the two alternative values of 124·3 and 170·6 kilo-calories/gram atom for the heat of atomization of carbon ($\Delta H_{291° K.}$ for the change $C_{\text{diamond}} \rightarrow C_{\text{gas}}$)[1], though the most recent treatment favours the higher value[2], and this also makes easier the correlation of some kinetic and thermochemical data[3].

An argument in support of the higher value may be got from the energy of the Hg—C link. The heats of combustion of mercury dimethyl, diethyl and diphenyl in their standard states at constant pressure are 432, 735 and 1,565 k.cal./gm. mol. respectively[4]. These values may be analysed with the help of the following data: heats of atomization (k.cal./gm. atom) C 124·3; H 51·7[5]; Hg 14·6[6]; associated bond energy terms (k.cal./gm. mol. C—C 58·6[7]; C=C 100[8]; C—H 87·3 [7]; benzene nucleus resonance energy 39 k.cal./gm. mol.[9]; latent heats for the phase changes (standard state to gas) $HgMe_2$ 8, $HgEt_2$ 9, $Hg(C_6H_5)_2$ 23 k.cal./gm. mol.[10]. The energies so obtained for the Hg—C bond are: from the dimethyl 1·5, from the diethyl 6·5, and from the diphenyl 3·5: mean 4 k.cal./gm. mol. Even though the energy needed to break the first C—Hg bond is probably greater by about 30 per cent than the mean value for the two bonds[11], 4 k.cal./gm. mol. is an unprecedentedly low value for a chemical bond, and is of the order of the van der Waals attractions.

If we use the higher value 170·6 for the heat of atomization of carbon (with the corresponding changes in the C—H, C—C, and C=C values) the Hg—C energy is increased by (170·6 − 124·3)/4 = 11·5, and becomes 15·5 (energy necessary to break the first C—Hg bond probably about 20 k.cal./gm. mol.). This seems much more probable; it is still very low, but of the same order as the P—P and As—As bonds (18·9 and 15·1[12]).

That the energy of the Hg—C link is very small is supported by many other facts. For example, the spontaneous decomposition of the dialkyls and (on heating) the cyanide to mercury and hydrocarbon or cyanogen; the abnormally low force constant derived from Krishnamurti's Raman spectrum of mercuric cyanide[13]; this is $1{\cdot}16 \times 10^5$ dynes/cm., probably the lowest yet found for any chemical link (we are indebted to Dr. L. A. Woodward for this calculation). Mercury can also be displaced from its alkyls by a great variety of metals (lithium, sodium, beryllium, magnesium, zinc, cadmium, thallium, tin, antimony, bismuth, tellurium). The common idea of the great stability of the mercury alkyls is derived from their indifference to air and water, which is mainly due to the small affinity of mercury for oxygen. But the value for Hg—C derived from the lower heat of atomization of carbon is so extremely minute that the higher value of 170·6 k.cal./gm. atom seems far more probable.

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H. D. SPRINGALL.

Chemistry Department,
University, Manchester.

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[1] See Skinner, H. A., *Trans. Faraday Soc.*, 41 (1945, in the press). The two values for the $\Delta H_{291^\circ K}$ for the diamond atomization are derived from the two alternative values for D_0(CO) 9·10 eV. and 11·11 eV. The fact that the use of the new conversion factors now raises the lower value of D_0(CO) to 9 14 eV. does not affect the treatment given here.

[2] Gaydon, A. G., and Penney, W. G., *Proc. Roy. Soc*, A, 183, 374 (1945)

[3] Baughan, E. C., *Nature*, 147, 542 (1941).

[4] Berthelot, M., *C.R. Acad. Sci.*, 129, 918 (1899).

[5] Pauling, L., "Nature of the Chemical Bond" (Ithaca 2nd Ed., 1940), 54.

[6] Bichowsky, F. R., and Rossini, F. D., "Thermochemistry of Chemical Substances" (New York, 1936), 69.

[7] Pauling, *op. cit.*, 53.

[8] Pauling, *op. cit.*, 131.

[9] Pauling, *op. cit.*, 136.

[10] Latent heat of fusion for the diphenyl from melting point by Walden's rule (*Z. Elektrochem.*, 14, 715; 1908). Latent heats of evaporation (at 25°) by assuming a Trouton constant of 21.

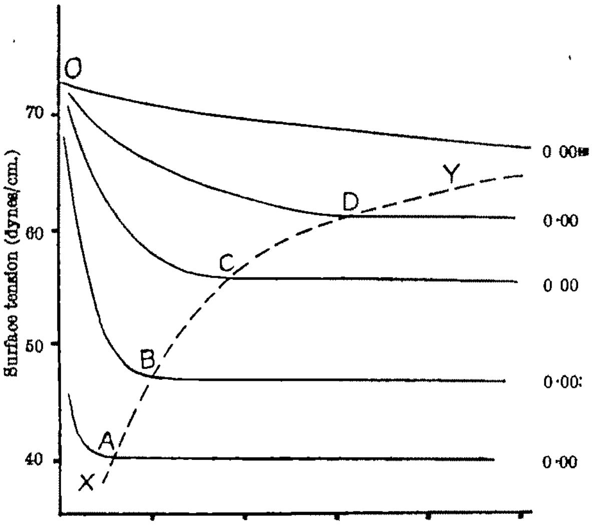
[11] Horn, E., Polanyi, M., and Sattler, H., *Z. phys. Chem.*, B, 17, 220 (1932). Wieland, K., *Z. phys. Chem.*, B, 42, 422 (1939). Butler, E. T., and Polanyi, M., *Trans. Faraday Soc.*, 39, 19 (1943).

[12] Pauling, ref. 7; but see Skinner, ref. 1.

[13] Krishnamurti, P., *Ind. J. Phys.*, 5, 633 (1930).

Time Factor in Service Tension Measurement

In recent years various authors[1] have applied static methods to the study of the slow changes which occur in the surface tension of aqueous solutions of some long-chain compounds; and in general the possibility that the accumulation of solute on the surface by diffusion from bulk solution might be responsible for the drift in tension is dismissed on the grounds that the periods of time involved may be as much as 10^9 times greater than those anticipated on classical diffusion theory. My recent quantitative studies of the adsorption process[2] using vibrating jets of aqueous alcohol solutions have confirmed that diffusion to the surface is complete within 10^{-4} to 10^{-1} sec. over the available range of chain-length and concentration, and similar results have been obtained with aqueous solutions of short-chain carboxylic acids. It seems clear that changes in tension over periods of hours, or even days, which occur in solutions of appreciable concentration (and which are usually smaller than the initial fall from the pure water value which occurs during development of the surface layer) are the result of rearrangements in the equilibrium adsorbed layer rather than of diffusion[1].



RELATION BETWEEN SURFACE AGE AND SURFACE TENSION AT 20° C. FOR AQUEOUS SOLUTIONS OF DECOIC ACID AT VARIOUS CONCENTRATIONS.

However, where intermediate time intervals a concerned, I have found that changes in tension du to both diffusion and rearrangement can be observe using the same experimental technique, and in som cases can be clearly distinguished. The time require for the establishment of a surface layer by diffusio diminishes with increasing chain-length, but is extended as the polar nature of the end group, and th dilution of the adsorbate, increase. Suitable combination of these properties can give rise to system in which the forces of diffusion will operate ove periods of time overlapping those employed in th 'slow drift' experiments. The accompanying grap shows the variation in surface tension with tim observed for aqueous solutions of decoic acid a several concentrations. The results were obtaine by a modified drop-weight method, which consiste essentially in the rapid formation of a drop of th solution of predetermined volume on a calibrate orifice, and measuring the time required for th tension to fall to a value equivalent to the dro weight (indicated by the falling away of the drop Full details of this work will be published elsewher

That the curves *OA*, *OB*, *OC* and *OD* represen the development of the surface layer under diffusio forces is supported by the fact that the form of th curves, and the times involved, are of the ord forecast by the general time-adsorption velocit equation deduced from the behaviour of shorter chai systems where diffusion alone can operate[3]. Beyon the points *A*, *B*, *C*, *D* the tension falls very slowl and readjustments in the established surface lay might well be responsible. It appears unlikely th the two factors can overlap, and extrapolation of t appropriate section of the time-tension curve to ze time assists in identifying the type of chan occurring.

In view of the existence of such systems, it is n possible to determine which factor is responsible f the change of surface tension by reference to t order of time alone, and it appears that the terminology, and in particular the expression 'time 'reach equilibrium' in common use in these studie requires some amplification. It is suggested that t use of both the terms 'dynamic surface' and 'dynamic surface tension' be restricted to those surfaces to which solute is in the process of diffusing. When this process is complete, the surface can conveniently be said to have reached dynamic or diffusion equilibrium. All older surfaces would then be termed static, and would reach static equilibrium only after rearrangements in the surface film were complete. The broken line XY in the graph thus traces the variation of diffusion equilibrium with concentration, and represents the boundary between static and dynamic tensions. Methods of measuring surface tension are classified by common usage as static or dynamic, and it is of interest from the above results that static (as well as dynamic) methods are capable of yielding both static and dynamic tensions.

C. C. ADDISON.

Harris Institute Technical College,
Preston.
July 30.

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[1] See Alexander, A. E., *Trans. Faraday Soc.*, 37, 15 (1941), and references therein.

[2] Addison, C. C., *J. Chem. Soc.*, 252, *et seq.* (1944); *Phil. Mag.*, 36, 73 (1945).

[3] Addison, C. C., *J. Chem. Soc.*, 354 (1945).

3 : 4-Benzpyrene from Coal Tar

THE extraction of the carcinogenic hydrocarbon 3 : 4-benzpyrene from coal tar, whether by the original method of Cook, Hewett and Hieger[1] (using repeated fractional distillation, extraction with solvents, formation of picrates, and crystallizations) or by Winterstein's modification[2] (involving chromatography), is generally considered too laborious, and the yields obtained too low, to serve as a practical measure for routine supplies. Hence the use of synthetic 3 : 4-benzpyrene for most experimental needs. When it was found[3], however, by a spectrographic method of estimation, that tar might contain as much as 1·5 per cent of benzpyrene, a re-investigation of the methods of isolating the hydrocarbon from tar seemed desirable.

Advantage was taken of the fact that sulphonation of benzpyrene does not readily occur with sulphuric acid alone in the cold, yet the hydrocarbon disappears completely from a solution on shaking with sulphuric acid. The expectation that the benzpyrene would be recoverable from the sulphuric acid washings (by dilution with water and re-extraction with an organic solvent) was confirmed; moreover, a quantitative test with pure benzpyrene yielded almost 100 per cent recovery. Its applicability as a means of isolating the hydrocarbon from tar seemed promising, since most other constituents of tar are either sulphonated by treatment with sulphuric acid in the cold, or else are left unextracted (the latter being the case, for example, with chrysene, and partly with pyrene).

Though the method was not practicable when applied directly to whole tar, owing to the very large amounts of sulphonated material obtained, it proved effective when tried on one of the crude distillation fractions of tar, obtained at 200–240° C. at a pressure of 0·1 mm. mercury (Hyvac and mercury pump), the fraction representing about 10 per cent of the original tar, and containing 2·4 per cent of benzpyrene (as estimated spectrographically).

10 gm. of this material in 100 ml. benzene was added to excess of petroleum ether, filtered, and the filtrate treated (at about 3° C.) with four successive lots of concentrated sulphuric acid. The pooled acid extracts were diluted with water, and extracted twice with benzene. The benzene extract was washed with dilute alkali, dried with anhydrous sodium sulphate, mixed with twice its volume of petroleum ether, and passed through a column of alumina (B.D.H.). The column was then developed with a benzene-petroleum ether mixture (1 : 2), and the early (non-crystallizable) eluates were discarded; the later eluates were collected, evaporated and several times recrystallized (from methanol and from petroleum ether). This yielded 75 mgm of a pale yellow crystalline product, possessing the characteristic fluorescence spectrum of 3 : 4-benzpyrene, and the following m.p. values:

Crystalline product from tar m.p. 171–173° C.
Synthetic sample for comparison m.p. 175–176·5° C.
Mixed m.p. 171·5–173·5° C.

The yield of 75 mgm. of almost pure benzpyrene from 10 gm. of a crude distillate of tar, by a relatively simple procedure, seems sufficiently promising for application of the method on a large scale as a practical means for supplying this important hydrocarbon.

I. BERENBLUM.

Oxford University Research Centre
of the British Empire Cancer Campaign,
Sir William Dunn School of Pathology,
University of Oxford.
Aug. 1.

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[1] Cook, J. W., Hewett, C. L., and Hieger, I., *J. Chem. Soc.*, 395 (1933).

[2] Winterstein, A., Festschrift Emil Barell, Basel (1936), quoted by Cook, J. W., and Kennaway, E. L., *Amer. J. Cancer*, 33, 50 (1938).

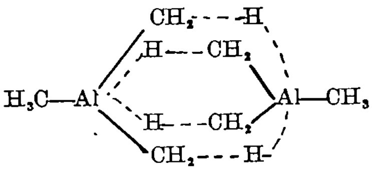
[3] Berenblum, I., and Schoental, R., *Brit. J. Exp. Path.*, 24, 232 (1943).

Aluminium Trimethyl

IN a recent letter, Burawoy[1] remarked that the ethane-like structure ascribed by us[2] to the dimeric form of aluminium trimethyl from electron diffraction investigations, and supported by Brockway and Davidson[3], is most unlikely. He proposed an alternative.

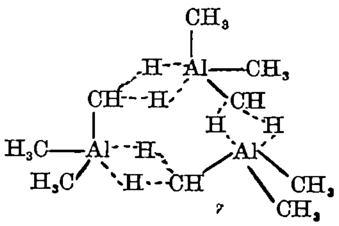
This method of examination does not enable us to deduce structures for such complicated molecules. They must be invented and tried; and for such a case, especially when not many orders of diffraction can be observed, it is impossible to say that any one satisfactory solution is unique. We have therefore tried Burawoy's model, and a number of others which we devised on various hypotheses about the type of binding without regard to their probability, for it is clear that the binding, whatever it is, must be new in some degree. We entertained the possibility that the degree of polymerization is more than two[4].

Burawoy's model proves unsatisfactory in both the qualitative and the quantitative fit of the simplified theoretical scattering curve with the observed scattering. We have, however, found three other more or less satisfactory models: I is a cage-type structure for the dimer; II is a ring structure for the trimer; III is a ring structure for the dimer with the ring not perpendicular to the plane of the other atoms. I is very good, II is quite good, III is fair. It may be recalled, also, that Brockway and Davidson rejected one of the ring models for the dimer (the sixth which they tried) more because it seemed improbable than because its scattering curve is bad. At present the experimental evidence available does not suffice for a definite choice between these possibilities to be made.



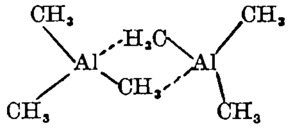
Model I

Al-C = 2·01; C-H = 1·09; Al..Al = 3·34, Al..C (ring) = 3·23 A.; ∠C-Al-C (ring) = 138°; ∠C-Al-C = 111°, C..H, Al..H not specified.



Model II

Al-C = 2·05; C-H = 1·09; Al..C (bridge) = 2·05; Al..H = 1·85; C..H = 1·30 A.; ∠s tetrahedral.



Model III

Al..Al = 3·20; Al-C = 2·05; Al..CH_3 = 2·59 A.: ∠C-Al-C tetrahedral throughout.

The structures which appear to do least violence to current theory are I and III. These could arise if the association were due primarily to polar character in the Al-CH_3 bonds (the methyl groups being negative). The attraction may be increased by some polarization of the methyl groups by the aluminium atoms which they approach.

A fuller account of the calculations and of the theoretical considerations will be given elsewhere.

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Concentration of Solutions of Salts of Penicillin

PENICILLIN as a chemotherapeutic agent is usually employed in the form of its sodium or calcium salt: a concentrated solution of one of these salts is used for parenteral injection or for local application. For the latter form of treatment penicillin in solid form is often used (usually the calcium salt). Owing to the instability of solutions of these salts of penicillin it is necessary to prepare and store the salts in the solid form and to dissolve in the appropriate volume of water or saline shortly before required.

In order to obtain salts of penicillin in the solid form, evaporation *in vacuo* of the concentrated solutions at low temperature is necessary, and the lyophilic drying process, in which evaporation takes place from the frozen state, has been the method of choice. The lyophilic drying process is, however, very slow, especially with the apparatus usually available in the laboratory, and it is therefore desirable to concentrate the solution as much as possible before drying.

This concentration may be achieved by extraction of the free penicillin at pH 2 with organic solvents, the salt being formed from the extract by treatment with the appropriate alkali and a smaller volume (for example, one tenth) of water[1,2,3]. This method of concentration may be repeated if necessary, yielding very highly concentrated solutions of the salt.

At alternative method of concentration which has advantages over that outlined above has been developed as the result of an observation made during the preparation of penicillin in these laboratories. Thus, it was noticed that frozen solutions of the sodium salt of penicillin when allowed to thaw at room temperature gave fractions varying in composition (for example, in pigmentation)[3]. The process has now been examined in more detail, and the 'drip-thaw' method, as used by McFarlane for fractionation of blood plasma[4], has been found suitable for concentrating solutions of the salts of penicillin. Preliminary experiments showed that penicillin potency could be correlated with the degree of pigmentation, and the volume of the respective fractions was determined by observing, as thawing proceeded, the progressive decrease in the colour of the drops of fluid. Satisfactory results were finally obtained by fractionating into three fractions.

Thus, in a typical experiment, a solution of the sodium salt of penicillin (400 c.c.) was frozen at −25° C. and the bottle containing the frozen solution was inverted and allowed to 'drip thaw' at room temperature. Three fractions were collected and there was a progressive variation in penicillin content, pigmentation and alkalinity. Assay tests showed that about 90 per cent of the penicillin content of the original solution was concentrated in the first fraction, which was highly coloured and about half the original volume; the second fraction, which was only pale yellow in colour, contained most of the small amount of penicillin remaining, while the third fraction (colourless and about one fifth of the original volume) contained less than 1 per cent of the penicillin content of the original solution.

By this process solutions of the sodium salt of penicillin with a potency, for example, of about 3,000 units per ml. may be fractionated to yield a first fraction with a potency of 5,000 units or more per ml., that is, to a potency suitable for parenteral injection.

Since the bulk of the penicillin content of the original solution is concentrated in the first fraction, the volume of solution for lyophilic drying is reduced to about a half. The fractional thawing may be repeated on the first fraction, for example, thus still further reducing the volume of solution for lyophilic drying. In one or two instances the lyophilic drying process has been omitted, and solutions of the sodium salt of penicillin have been concentrated to a high potency by the above method, and have been stored for several weeks in the frozen state without appreciable loss of potency.

Assay tests on the fractions have shown that, as would be expected, there is practically no loss of penicillin; the process is easily carried out, requiring little attention, may readily be accomplished under aseptic conditions, and is, in fact, ideal for the concentration of solutions of unstable substances such as the salts of penicillin.

The method is suitable for the concentration of solutions of the calcium salt of penicillin, and it may o be of value for the concentration of solutions other antibiotics or of antibacterial substances.

We wish to thank Dr. C. P. Stewart, of the Blood ansfusion Service, Royal Infirmary, Edinburgh, providing facilities for the freezing of the solutions penicillin used in this work.

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Dec. 17, 1943.

ublication delayed for security reasons. Editors.]

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xual Differentiation of the Gonad and the Sexualization of the Germ Cells in Teleosts

In the Amphibia and Amniota, the original exuality of the gonad is evident from the dual gin of its two main constituents—the *cortex* from e peritoneal wall, and the *medulla* from the interal blastema[1]. Sexualization of the germ cells, ich are originally indifferent, results from the action one or other of the sexual differentiators which produced in these areas, *medullarin* inducing aleness and *cortexin* femaleness (Witschi).

With this in view, several authors (Essenberg, ldine, Dantschakoff, Lepori) have tried to identify rtical and medullary regions in the gonads of leosts. My own observations on several species do t support such a double origin, and a critical examation of the literature leads me to believe that in e Teleosts generally (as judged from the species idied to date) the somatic substratum of the gonad s a simple origin from the peritoneal wall.

In the Teleosts, as in the Cyclostomes[2], the germ lls do not at first exhibit male and female characterics, which appear later in development. The mordial germ cells or *protogonia* (Beccari) multiply a certain number of generations, giving rise to lls which I call *deutogonia*, becoming separated from ch other or temporarily united into small groups. ese are always sexually undifferentiated. The nale cells first become recognizable oocytes during maturative prophase and during the processes of owth and deutoplasmogenesis ; the male cells first close themselves as such when they multiply to m encysted groups of secondary spermatogonia. e two sexes are thus first distinguishable by the owth and suspension of division on the part of the nale cells, and the continued multiplication within sts of the male elements. Between these two exmes every degree of intermediate condition is to found, giving cells in a state of *intermediate uality*.

Growth, deutoplasmogenesis and meiotic prophase y be initiated in cells which are derived, after a ies of generations, from the early protogonia, but y may also set in immediately in the first generaa of deutogonia, a condition which we have erred to as *abbreviated oogenesis*[3].

We see therefore that the development of the germ ls is characterized by an initial state of indeterminacy, which applies also to the gonad as a whole. This is particularly evident in the eel, and I think is the primitive condition in the Teleosts[4]. In the eel we can trace, from an initial indifferent condition, the progressive sexual orientation of the gonad with an increasing predominance of the germ cells of either male or female type. Parallel with this there is a regression of the heterologous sex elements and the accentuation of the male or female structure of the gonad. In the male these changes are recognizable in the development of the vas deferens and in the cordonal arrangement of the spermatogonia, and in the female in the lamellar arrangement of the oocytes.

The initial state of the gonad, as described above, is one in which the two opposing tendencies are balanced and can be defined as *intersexuality*. According to Goldschmidt[5], the essential difference between intersexuality and hermaphroditism lies in the temporal succession of two opposing tendencies in the first and the co-existence of both in the second. In my opinion, intersexuality is rather characterized by the incompatibility between the two tendencies, and hermaphroditism by their mutual tolerance[6]. This difference is probably due to the diffusible or non-diffusible nature of the sex differentiators.

Among the Teleosts we have a typical example of hermaphroditism in *Sparus auratus*[7]. Here, in the same gonad, the protogonia localized in the marginal ventral portion become differentiated in the male sense, while those distributed along the median and partly along the lateral walls of the central cavity differentiate in the female sense. In this case differentiation of each germ cell proceeds directly in one direction or the other with no intermediate condition of intersexuality. In *Sparus* there is constant *protandry*, that is, the male germ cells mature before the female.

In the Sparidæ there are other species (for example, *Diplodus* spp.) in which the testicular and ovarian areas likewise appear in the same gonad, but only one of them reaches maturity. Here, therefore, we see the transition from hermaphroditism, which must be considered as the primitive condition, to gonochorism.

With *Sparus auratus*, as in all cases of hermaphroditism, there is a genetically determined balance between the two opposing sex potencies. The differentiation in the same individual of male and female gonocytes cannot be interpreted as the direct effect of hereditary factors, but must be regarded as determined by the surrounding somatic tissue. The spatial separation of the protogonia destined to form sperm and ova lead us to believe that the somatic tissues of the gonad are chemodifferentiated into regions producing either male- or female-inducing substances.

Even in the eel, where there is no spatial separation of prospective male and female protogonia, we are led to the same general conclusion. The ultimate sexualization, which takes the form of an increasing predominance of one type of germ cell over the other, must be induced by local influences in the surrounding somatic tissue of the gonad[8].

In the Amphibia this is still more obvious. The protogonia become oogonia if they remain in the cortex of the gonad. If, however, they migrate into the medulla, they become spermatogonia. If migration is incomplete or delayed, the result is a condition of intermediate sexualization[9].

It would thus appear that in the vertebrates generally the germ cells are originally indifferent and later become sexualized under the influence of the somatic substratum of the gonad. This conclusion seems at first sight paradoxical and at variance with the widely held belief in the continuity of the germ plasm. It seems that the sex of the germ cells is not determined by genetic factors passed directly from the zygote through a series of germinal cell generations. But in species with genotypic sex determination, the sex-determining influence appears to pass first to the somatic tissues, which in turn induce the sexualization of the germ cells. In species in which there is a balanced genotypic sexuality (intersexuality), sexualization of the germ cells is likewise probably due to influences originating within the organism or from the external environment and acting always through the somatic substratum of the gonad.

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Use of Dibenzylphosphoryl Chloride for Phosphorylations

ABOUT ten years ago, one of us (A. D.), at the suggestion of Dr. P. Eggleton, began experiments on the synthesis of some biologically important phosphorous compounds at the Physiology Department of the University of Edinburgh. In the course of these experiments, the chloride of dibenzylphosphoric acid was prepared and its usefulness proved in preliminary experiments. This work had to be broken off and could not be resumed until recently.

In the meantime, L. Zervas[1] has introduced the silver salt of dibenzylphosphoric acid as a phosphorylating agent; he considers the chloride too unstable for convenient use in phosphorylations.

We find that the chloride, prepared according to our original procedure from the potassium salt of dibenzylphosphoric acid with thionyl chloride in chloroform, is sufficiently stable for preparative use in phosphorylations. Guanidine dibenzylphosphoric acid can easily be prepared by shaking the chloride with a 25 per cent guanidine solution. Within a few minutes the oily chloride disappears and a solid is precipitated. After filtration and washing with water, the crude product is recrystallized from alcohol-ether; m.p. 166·5–167·5° C.; yield 80 per cent. By hydrogenation with a palladium catalyst, guanidinophosphoric acid is obtained. We have prepared a number of substituted amino- and guanidinophosphoric acids and are at the present time occupied with experiments on the phosphorylation of hydroxy-compounds.

When treated with a cold dilute potassium hydroxide solution, dibenzylphosphoryl chloride yields the tetrabenzylester of pyrophosphoric acid in good yield; m.p. 59–60° C. The substance is insoluble in water, soluble in alcohol and ether and decomposes with warm alkali to form dibenz phosphoric acid. Our attempts to prepare tribenz pyrophosphoric acid by partial saponification hydrogenation of the tetrabenzylester have hither been unsuccessful.

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June 29.

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Air Photography in the Far East

THE recent article[1] by Wing-Commdr. Hamsha Thomas is very timely. I have recently been attach to H.Q., S.E.A.C., so I have had considerable opp tunity of seeing the part played by air photograp in that region. When the time comes for the f story to be told, it will be found that many of th applications are likely to be those described in th recent article. My present purpose, however, is put on record a plea for the continuation of R.A. air survey in the tropics as well as in England. T need in the Far East is even greater than in Gre Britain, because many of the tracts of country a almost inaccessible. One need scarcely say that th governments concerned, for example, India, Ceylo Malay and Burma, are fully aware of the great val of air survey, but too often decisions are made Great Britain by people who are not familiar wit the needs elsewhere. Here one may refer to the aeri surveys carried out for the forest service in Burm for example, Irrawaddy and Lower Tenassarim, b tween the two Wars, though for present-day purpos these were on a small scale. There has also be great improvement in technique since these survey were carried out, and much of the work must requi repetition.

One or more units of the R.A.F. ought to be mai tained in the Far East and their work made availab to the resident scientific men and government depar ments. In this connexion also it is to be hoped th the vast collection of photographs now accumulat in the Far East will not be destroyed but made ava able in the near future to men of science for stud Finally, there is not only the question of the co tinuance of air survey, but there is also the proble of service photographic research. It is highly desi able that this should be continued, not only in Gre Britain but also in the tropics. Conditions for phot graphy are obviously completely different in th tropics, and we have by no means fully master them. They cannot properly be overcome by sim lating tropical conditions in Britain, and it is mo important that a photographic research unit shou be set up and maintained in either India or Ceylo This unit could operate as an out-station of the ma research centre in Britain. During the course of the investigations, if there is proper co-ordination betwe them and local scientific men and local needs, mu useful work could be done. This type of peace-tim co-ordination is already in evidence at the arm photographic research centre in Wiltshire. It is be hoped that the R.A.F. will follow suit.

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ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX

ANNUAL CONFERENCE

HE twentieth Conference of the Association of Special Libraries and Information Bureaux, held the Portland Hall, Polytechnic Extension Building, ndon, during September 15–16, drew the largest endance of recent years, and the new *venue* proled more of the opportunities for informal dission and contacts which were such a useful feature the residential conferences arranged before the ar. Even at the conversazione at the Royal titute of British Architects on the Friday which ceded the formal opening it was evident that this s appreciated; and there was, further, a clear desire a conference to be held in a northern and industrial tre which afterwards found expression at the nual general meeting and in the discussion which lowed Mr. E. N. Simon's paper, "Some Problems the Special Librarian in Industry". The liveliness the discussion on that paper, like that on Mr. E. J. rter's paper on "The Planning and Equipment of search Libraries and Information Bureaux", inated that the time available was all too inadequate. deed, the general impression was gained that these o sessions, with that at which Miss M. Bateman sented her paper, "Some General Desk Reference oks", the discussion on the book shortage over ich Mr. L. J. F. Brimble presided, and some portunity for informal discussion of the ideas own out by Prof. J. D. Bernal in his opening dress, would have provided more than enough, addition to the formal business, to satisfy the jority of those attending.

n contrast to the usual practice, the Conference ened with the annual general meeting at which report of the year's work was presented. Memberp has risen to 530, and the subscriptions increased £1,500. Grants of £300 from the British Council 1 £1,000 from the Department of Scientific and lustrial Research were received during the year, d the income and expenditure account shows a plus for the year of £241.

nly two Library Training Courses were held durthe year, and the second of these did not end til July 1945. The first issue of the *Journal of cumentation* appeared in July 1945 and nonmber subscribers to the ASLIB Book List now mber 424, including 230 copies distributed through British Council. Preliminary steps have been en towards the compilation of a "Directory of dical Libraries and Sources of Information", and ew edition of the "Select List of Standard British entific and Technical Books" is also in preparation. Publications Committee has also been responsible editing a guide to "British Sources of Informa1", commissioned by the British Council for the of libraries overseas. ASLIB has also collaborated h the Library Association and the National tral Library in compiling a list of American iodicals missing in transit or through enemy on during recent years. This is the first step in heme by which it is hoped that some replacements y be obtainable through co-operation with erican libraries, even when the issues in question out of print.

Following the annual meeting, Prof. J. D. Bernal gave a challenging address on "Information Service as an Essential in the Progress of Science". Dealing primarily with the user's side of library service in relation to research, Prof. Bernal made a strong plea for closer co-operation between the librarian and the research worker and for a fuller understanding of each other's needs and problems. The modern information service should endeavour first to secure that the right information in the right form was sent out to the right people, and, secondly, to arrange that facts of diverse origin which might bear on any particular topic should be correlated for the study of that topic. The very fact that the productive capacity for scientific information increased so greatly, while the absorptive capacity did not increase, accentuated the importance of these distributive and integrative aspects of library service, and Prof. Bernal suggested that in the future the librarian should be master of the material itself and be in a position to present it in forms different from those in which he receives it. It is the librarian's job not merely to accept material as sent to him, but also to demand that the material be presented in the appropriate forms for passing on. This implies a much closer relation between the librarian and the research worker as well as between the function of the librarian and that of the publisher, and Prof. Bernal referred to the way in which war-time experience of the dangers of departmentalism in information service had emphasized the unity of the whole question of scientific communications. It had become clear that, so far as information service for furthering research was concerned, a thorough recasting of the whole system was required, and the present period of rehabilitation offered a unique opportunity for a new start.

The primary unit in scientific communications was the individual scientific paper dealing comprehensively with one topic, and in Prof. Bernal's opinion the scientific journal had ceased to be a really satisfactory means of distributing scientific information. He suggested that the individual scientific paper was the proper basis for distribution as well as for publication. Under the proposed scheme the papers, after being passed for publication by referees, would be forwarded by scientific societies to a national centre which would act as clearing house. The papers would be published in three lengths: in full, possibly as microfilm; in the main, printed; and in summary or abstract. Prof. Bernal visualized a unified abstract service. For indexing, the title of the paper would be sufficient for most purposes. The scientific societies would retain their editorial functions, but it was particularly important that the scheme should be on an international basis from the start, and librarians who were able to appreciate the need for order and uniformity in the presentation and distribution of information should stress to scientific societies and governments the folly of independent action.

At the afternoon session when Sir Frederic Kenyon presided over a symposium on "Links with the U.S.A.", there were some striking omissions. Miss Taylor read a paper by Dr. R. H. Heindel on "The American Library in London" and indicated that this was likely to be retained in some form or other. The arrangement by which H.M. Stationery Office will act as a sales agent for the publications of the U.S. Government Printing Office was also mentioned as likely to operate in the near future, and the paper was supplemented by a list of some guides to American publications. Mr. R. H. Hill read a joint paper with Mr. E. G. Tayler describing the Bureau of American Bibliography established at the National Central Library on January 1, 1938, and the collaboration of the National Central Library with the Committee on International Relations of the American Library Association in the distribution of American books and periodicals to men serving in the British Forces at home and overseas. Mr. W. C. Dalgoutte described the British Information Services in New York and the work of its four divisions—information, including the library, which is the main link between the organization and American libraries; press and radio; general, including speakers and circulation; and films; and he referred to the growing demand for information on Britain's financial and economic position. In a paper on the work of the American and British Commonwealth Association, Major W. E. Sinnett referred to plans for an Anglo-American Library of Reference which were in abeyance with the formation of the American Library under Dr. Heindel, and to the foundation of an Anglo-American Institute of Cultural Relations and Study. Mr. L. R. McColvin outlined cultural relations with the United States organized by the Library Association, and a paper by E. S. Cavanaugh on the work of the Special Libraries Association was read by Miss Ditmas in which the proposal for an Educational and Cultural Organisation of the United Nations was welcomed and reference made to Mr. Archibald MacLeish's plan for inter-library loans on an international basis to help the devastated libraries in Europe.

A paper on exchanges of staff and students between British and American universities, by Mr. R. A. Johnson, appeared singularly out of date. Taken from an article published in October 1944, it omitted all reference to the more recent arrangements such as that between the University of Manchester and the University of Virginia. Among papers presented in person were those of Mrs. Beatrice Warde describing the operations of the "Books Across the Sea" societies and of E. A. Ford on the "Educational Work of the English Speaking Union", but in an overloaded symposium there was little reference to the scientific field and none at all either to the work of the Scientific Offices in Washington or in London or to the important proposals in the recent report of Dr. Vannevar Bush.

By way of contrast, almost the whole of the following session was given over to lively discussion of Mr. E. N. Simon's paper. Possibly Mr. Simon overstressed the need for education inside a company—his own experience on this point was not generally corroborated—but there can be no question as to the importance of more propaganda on the part of ASLIB. The Association has sometimes tended to preach too much to the converted, and Dr. W. H. Brindley's suggestion for more joint or conjoint meetings of ASLIB with the scientific societies and professional associations should be followed up. Mr. Simon himself indicated that the primary task of the information officer is to direct his clients to reading, not to read for them, and in fact the technique of good showmanship is an important part of the equipment of a first-class works librarian as of the public librarian. Mr. Simon gave frank expression to a number of problems, internal and external, with which most librarians are confronted, and succeeded in conveying a point of view that is not always recognized. Not every librarian appreciates the ha
that, is done by automatic reminders or reca
whether or not the borrowed volume is actually
quired for use elsewhere, though, of course, ev
librarian knows that in the absence of a remin
system the book may never come back, whethe
is in use or not. The question of co-operative tran
tions Mr. Simon discussed at some length and a
the functions of ASLIB, and if all his strictures co
not be maintained the plea for a northern confere
received strong support. Such a conference sho
do much to remove the main burden of Mr. Sim
strictures on the Association—that its discussi
are conducted in too general terms, insufficiently
lated to specific problems; and if at the same ti
the suggestion that active steps should be taken
enlighten chambers of commerce, sales manag
associations, bankers, municipal officials and oth
as to the importance and value of information servi
is adopted the steady growth of the industrial me
bership of ASLIB may in itself supply whate
further impetus is required for the movement ur
by Mr. Simon.

Mr. Edward Carter's paper on the planning a
equipment of research libraries and informat
bureaux at the Sunday morning session, over wh
Mr. S. W. Gibson presided, alone would have gi
value to the Conference for the industrialist, but o
again the session was overloaded by bringing
Mr. C. E. A. Bedwell's paper on "Hospital Libr
Accommodation", which not only curtailed the
cussion but was clearly regarded by the majority
those present as extraneous, if indeed it fell prope
within the sphere of ASLIB at all. Mr. Car
emphasized the importance of flexibility of plan a
freedom to expand and suggested accordingly t
the least possible amount of equipment should
fixed. Increase in size inevitably compels chan
in the qualitative elements of a library's organi
tions, including the main plan elements, doorw
and walls as well as equipment, and changes sho
be allowed for, even if they cannot be calculated
detail. Moreover, provision for expansion sho
cover not merely straightforward increase in ho
ings but also increase or intensification of servi
Usually this will mean more staff for whom wo
place must be found, and this is often difficult exc
at the expense of reader-space even if the sou
principle is observed—not, however, mentioned
Mr. Carter—that only those members of the librar
staff actually responsible for service to readers sho
be located in the reading-room itself.

Without dealing in detail with library planning,
Carter indicated his objections to the university t
with reader's bays and emphasized the desirabi
of the librarian's own room being situated where
will be in close contact with both readers and st
On lighting and acoustics he made many import
practical observations, and his comment that it i
important to prevent noisy conditions in ro
where staff are at work on tasks demanding concen
tion as in reading rooms will be appreciated.
pointed out that a sustained background noise
traffic or machinery is generally not troublesome
can even be helpful in muffling foreground distu
ances such as conversation, a squeaky pen and
on. Readers prefer, he finds, to sit facing rat
than alongside each other unless the space betw
adjacent readers is very generous. Something m
than minimum seating comfort is one of the ameni
which any but the poorest research body sh

afford, and all shelving should be adjustable. Mr. Carter's whole paper is packed with observations, notes on minimum standards, and data for calculations for accommodation and design which should be valuable even to the experienced works librarian, and further comments on a number of his points are to be found in S. Rowland Pierce's "Some Notes on the Planning of Research Libraries", who expresses the opinion that where doors are not provided to the bookshelves there should be no books between twelve or eighteen inches of the floor.

There is room for more discussions of the type that followed Miss M. Bateman's paper on "Some General Desk Reference Books" at the afternoon session on September 16, though the speakers betrayed a tendency to think in terms of specific reference books rather than those of a general, all-round usefulness. This session was followed by a discussion on the great book shortage, over which Mr. L. J. F. Brimble presided. This was opened by a paper by Miss E. M. R. Ditmas who, after recapitulating the causes of the shortage, referred to its effects in education and research and its bearing on Empire intercommunications and the re-establishment of cultural relations with Europe. In regard to research, Miss Ditmas quoted figures supplied by the research department of a large firm carrying on research of vital national importance, showing how the position has steadily deteriorated since 1942 and the dependence on American rather than on British books—a dependence which, with the termination of Lend-Lease, may have serious repercussions on industrial and scientific development if books are regarded as articles of luxury or merely a commodity of trade. The immediate demand for British publications is far in advance of the normal pre-war demand, while stocks are at their lowest. The discrepancy between supply and demand grows monthly, but the remedy must take account of labour n both the paper-making and the printing and bookbinding industries as well as transport and materials.

In the lively discussion which followed, Miss Ditmas's remarks in regard to the effect of the book shortage on research was stressed by Dr. V. E. Parke and other speakers, including the chairman, who expressed the opinion that books needed for research and for the universities were more important than hose needed for schools, where the numbers run into hundreds of thousands of volumes. Reference was made to the possible help of the American Library n arranging facilities for inspecting American books which could not be obtained on approval, and the hairman endorsed a deserved tribute paid by Prof. R. S. Hutton to the services of Messrs. H. K. Lewis and Co., Ltd., and other leading booksellers in prouring American literature. Mr. H. L. Jackson, of Messrs. H. K. Lewis and Co., Ltd., thought that Miss Ditmas had given a very good account of the position and that the shortage was most acute in the educational field. Confirming that the labour position rather than the paper shortage* was the most acute difficulty, he suggested that it would be better to send a deputation with a resolution rather than submit a resolution nly from the Conference. After further discussion a resolution was approved suggesting that the Council f the Association of Special Libraries and Information Bureaux should take definite action along such ones, either by a deputation to the Ministry of Labour or other Ministry or by way of resolution.

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* Since this discussion was held, a fifteen per cent increase in paper location has been announced.

CHEMICAL COMPOSITION OF MARINE ORGANISMS

THE data on the chemical composition of marine organisms are widely scattered; hence Prof. A. P. Vinogradov's paper on "La composition chimique élémentaire des organismes marins" (*Trav. Lab. Biogéochimique, Acad. Sci. URSS.*, Pt. 1, 1937, Pt. 2, 1941, Pt. 3, 1944) is a valuable contribution to our knowledge of the elemental chemical composition of marine plants and animals; it is in Russian. Essentially it represents a compilation of many thousands of elemental analyses of marine organisms, and the bibliography alone, printed in double columns in close type, occupies 44 pages. The data presented are accompanied by extensive critical discussion and comments. Part 1 embraces Algæ, Bacteria, Protozoa, Porifera and Cœlenterata; Part 2, the remaining Invertebrata and a part of a chapter on the chemical composition of respiratory pigments; and this chapter is carried over to Part 3, which also contains additional notes on the composition of Invertebrata, composition of Pisces, composition of skeletal parts of animals, a general summary and special chapters dealing with the problems of geology and evolution from the biogeochemical point of view.

Although the collection of analyses appears to be enormous, its usefulness in its present form is somewhat limited, mainly because the analyses are usually confined to certain chemical elements found in certain parts of organisms (soft parts, skeleton, ash, etc.), and there is no attempt made to evaluate the composition of complete organisms. This means that any attempt to give a generalized view of the chemical composition of individual species is bound to be rather vague, and any comparison between them very difficult. This fault certainly does not lie with the author, whose perseverance in collecting these data is truly remarkable. In spite of these difficulties the author makes an attempt to trace the relation existing between the composition of organisms and the composition of the ocean and to find out the major changes in chemical composition of organisms during geological time.

From the point of view of geology, or rather of biogeochemistry, as this branch of science is now called in the U.S.S.R., an especially important question is that of the concentration of certain chemical elements by marine organisms, which often leads to the deposition of rocks of biogenic origin, such as limestone, diatomite, manganese and iron ores and petroleum. "Marine organisms, concentrating certain elements and dispersing others during the process of their living activity, are performing complex and varied geochemical functions. Their chemical elemental composition, as shown by thousands of analyses, does not appear to be a simple reflection of the chemical composition of the surrounding medium. The varying chemical composition of the organism is determined by their physiological character, which in its turn is produced by lengthy interaction between each organism and its medium. On closer investigation we can discover that the chemical composition of the organism reflects its genetic history." According to the author, each species of organism is characterized by its own chemical composition, which has remained more or less constant throughout geological time, and only new species show a marked change in composition.

S. I. TOMKEIEFF.

FORTHCOMING EVENTS

Monday, November 19

Royal Society of Arts (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Dr. F. C. Bawden. "Virus Diseases of Plants", 1 "Symptoms of Virus Diseases" (Cantor Lectures).

Royal Geographical Society (at Kensington Gore, South Kensington, London, S W.7), at 5.30 p.m.—Mr. C. P. Skrine. "Persia and Afghanistan" (Kodachrome films and commentary).

British Institution of Radio Engineers (at the Birmingham Chamber of Commerce, 95 New Street, Birmingham 2), at 6.15 p.m.—Discussion on the Radio Industry Council Report on "Post-War European Broadcasting" (to be opened by Mr. A. H. Cooper).

Tuesday, November 20

Royal Society of Arts, Dominions and Colonies Section (at John Adam Street, Adelphi, London, W C.2), at 1.45 p.m.—Dr. G. Macdonald "Tropical Hygiene and the Overseas Empire".

Royal Institution (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Dr. Kathleen Lonsdale, F.R S. "Recent Research Work in the Davy Faraday Laboratory" (1) "Atomic Movements in Crystals".

Eugenics Society (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 5 30 p.m.—Dr. A S. Parkes "Some Problems of Reproductive Physiology".

Association for Scientific Photography, Medical Group (at the Hastings Hall, B M A House, Tavistock Square, London, W.C.1), at 6 p.m.—Discussion on "Equipment for Medical Photography". (to be opened by Dr. A. C. Roxburgh and Mr. J. E. Andrews).

Royal Photographic Society, Scientific and Technical Group (at 16 Prince's Gate, London, S.W.7), at 6 p m.—Dr. W. F. Berg: "How it Works in Photography", 2. "Latent-Image Theory without Tears".

Wednesday, November 21

Royal Society of Arts (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m —Mr. Henry Berry "The Thames Conservancy".

Institution of Electrical Engineers, Radio Section (at Savoy Place, Victoria Embankment, London, W.C.2), at 5 30 p m.—Mr. J. R. Brinkley "A Method of Increasing the Range of V.H.F. Communication Systems by Multi-Carrier Amplitude Modulation".

Institute of Fuel (at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1), at 6 p m.—Dr. M. Fishenden and Dr. O. Saunders. "Heat Transmission" (Second paper in the Industrial 'Waste Heat' Recovery Series).

Society of Chemical Industry (at the Royal Institution, Albemarle Street, London, W.1), at 6 15 p m.—Sir Harold Hartley, F.R.S.: The first H. E. Armstrong Memorial Lecture (members of the Plastics Group are particularly invited).

Institute of Welding, Wolverhampton Branch (at the Victoria Hotel, Wolverhampton), at 7 p.m.—Mr. T. E. Calverley. "Electrical Technique in Resistance Welding".

Thursday, November 22

Institute of Physics, London and Home Counties Branch (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 5 p.m —Dr. J. M. Meek and Mr. C. E. R. Bruce. "Some Recent Theories of the Electrical Discharge".

Royal Institution (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Prof. James Gray, F.R.S: "The Anatomy and Functions of the Brain in Lower Vertebrates" (iv) "Mammals"

Chemical Society (joint meeting with the University College of North Wales Chemical Society) (in the Department of Chemistry, University College, Bangor), at 5 30 p m.—Prof J. W. Cook, F.R.S.: "Colchicine, its Chemistry and some Biological Effects".

Friday, November 23

Royal Institution (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Prof. J. D. Bernal, F.R.S.: "Lessons of the War for Scientists".

Bedson Club (in the Chemistry Lecture Theatre, King's College, Newcastle-upon-Tyne), at 5.30 p m.—Prof. G. F. Marrian, F.R.S.: "Some Aspects of the Biochemistry of the Corpus Luteum Hormone" (Sixty-first Bedson Lecture).

Institution of Electrical Engineers, Measurements Section (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Dr. J. M. Meek: "The Influence of Irradiation on the Measurement of Impulse Voltage with Sphere-Gaps".

Institution of Mechanical Engineers (at Storey's Gate, St. James's Park, London, S W.1), at 5.30 p.m.—Miss Verena Holmes: "The Place of Women in Post-War Engineering".

Chemical Society (joint meeting with the Local Sections of the Royal Institute of Chemistry and the Society of Chemical Industry) (at University College, Cardiff), at 6.30 p.m.—Prof. J. W. Cook, F.R.S.: "Colchicine, its Chemistry and some Biological Effects".

Association of Scientific Workers (at the Onward Hall, 207 Deansgate, Manchester), at 7 p.m.—Dr. W. A. Wooster. "Science To-day in the U S.S R.".

British Association of Chemists, St. Helens Section (at the Y.M C.A. Buildings, St. Helens), at 7.30 p.m.—Dr. N. Thorley: "Chemical Analysis by X-Rays".

Saturday, November 24

Institution of Mechanical Engineers, Graduates' Section (at Storey's Gate, St. James's Park, London, S.W.1), at 3.30 p m.—Mr. A. C. Hartley "Operation PLUTO" (Annual Lecture).

APPOINTMENTS VACANT

Applications are invited for the following appointments on o before the dates mentioned.

Clinical Psychologist to the Berkshire Child Guidance Clinic—The Medical Superintendent, Berkshire Mental Hospital, Cholsey Berks. (November 21).

Senior Engineering Assistant on the staff of the Boroug Engineer's Department—The Borough Engineer, Town Hall, We Ham, London, E.15 (November 24).

Engineering Assistant to the River Roding Catchment Board—The Clerk of the Board, National Provincial Bank Chambers, Romford Essex, endorsed 'Engineering Assistant' (November 24).

Assistant Chief Engineer by Oil Company in Trinidad—Th Ministry of Labour and National Service, Appointments Department Technical and Scientific Register, Room 670, York House, Kingsway London, W.C.2, quoting C.2881 XA (November 24).

Senior Physicist (man or woman) by British Leather Manufacturer Association, to organize and collate investigations on physical properties of leather—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, Yor House, Kingsway, London, W.C 2, quoting A.1141 XA (Novembe 24).

Chief Chemist, a Junior Technical Engineer, a Combustio Engineer, and three Assistant Planning Engineers, in the Fulham Borough Council's Base Load Generating Station—The Town Clerk Town Hall, Fulham, London, S W 6 (November 26).

Chief Water Inspector—The Chief Engineer, Southend Waterworks Co., 13 Cambridge Road, Southend-on-Sea, endorsed 'Personal—Chief Water Inspector' (November 26).

Lecturer in the Mathematics and Physics Department—Th Clerk to the Governors, South-East Essex Technical College an School of Art, Longbridge Road, Dagenham, Essex (November 26)

Senior Assistant Lecturer (full-time) in Mechanical Engineering Subjects to Honours Degree and Higher National Certificat standards in the Cardiff Technical College—The Director of Education City Hall, Cardiff (November 27).

Laboratory Technician (with special experience in Histology)—The Medical Director, Ashford County Hospital, Ashford, Midd (November 28).

Assistant Lecturers (2), one in the Department of Mathematic and one in the Department of Physics—The Secretary, King's Colleg Strand, London, W.C.2 (November 30).

Demonstrator (temporary) in Physiology in the Medical School—The Registrar, King's College, Newcastle-upon-Tyne (November 30)

Deputy Water Engineer and Manager of the Warrington Corporation Waterworks—The Town Clerk, Town Hall, Warrington endorsed 'Deputy Water Engineer and Manager' (November 30).

Executive Engineers (2) in the Public Health Engineering Department, Government of Bihar—The Ministry of Labour and Nationa Service, Appointments Department, Technical and Scientific Registe Room 670, York House, Kingsway, London, W.C.2, quoting E.3013. (November 30).

Irrigation Engineers for Burma—The Ministry of Labour an National Service, Appointments Department, Technical and Scientifi Register, Room 670, York House, Kingsway, London, W C.2, quotin E 2098.A (November 30).

Physicist or Applied Mathematician, with research experience, by British Cotton Industry Research Association, to carr out theoretical and experimental studies of vibrations in machines—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting A.1149.X (November 30).

Lecturer in Refractories, and a Lecturer in Chemica Technology—The Secretary, Imperial College, Prince Consort Road London, S.W.7 (December 15).

Lecturer in Physical Chemistry, and an Assistant Lecture in Chemistry—The Registrar, The University, Sheffield (December 31

Assistant Advisory Mycologist—The Dean of the Faculty o Agriculture and Horticulture, The University, Reading.

Demonstrator in the Department of Geology, and a Junio Research Worker and part-time Demonstrator in the Department of Zoology—The Secretary, Bedford College for Women Regent's Park, London, N.W 1.

Graduate Teacher of Geography at the Folkestone Count Technical School for Girls—The Divisional Educational Officer, Ol Harvey Grammar School, Foord Road, Folkestone.

Laboratory Assistant (female) of Inter. Sci. standard for work i a Biological Laboratory—The Pharmacological Department, Pharmaceutical Society, 17 Bloomsbury Square, London, W.C.1.

Lecturer in Mechanical Engineering Subjects—The Principa Erith Technical College, Belvedere, Kent.

Lecturer in Rural Science and Biology at the City of Bat Training College—The Director of Education, Education Departmen Guildhall, Bath

Library Assistant—The Secretary, Institution of Automobi Engineers, Research Department, Great West Road, Brentford, Midd

Research Assistants (should possess good honours degree Economics, Statistics or Mathematics) for the Ministry of Town an Country Planning Headquarters in London—The Ministry of Labou and National Service, Appointments Office, 1–6 Tavistock Squar London, W C 1, quoting C D 10.

Scientific Officers and Senior Scientific Officers, and Assistant Experimental Officers and Experimental Officers, to f vacancies on the scientific staffs of Government Departments—T Secretary, Civil Service Commission, Burlington Gardens, London, W.

Secretary with some knowledge of medical sciences (main wo would be preparation of abstracts of medical literature)—The He of the Department of Pharmacology, Oxford.

Senior Laboratory Steward for Department of Organic Chemistry—The Registrar, The University, Liverpool.

Teachers (part-time) for Evening Classes in Mathematics (Matric. Geography (Matric.), Elementary Physics and Chemistry f Dental Mechanics—The Secretary, North-Western Polytechn London, N.W 5.

PHYSICS Dept. Upper Circular Rd, Calcutta

NATURE

No. 3969 SATURDAY, NOVEMBER 24, 1945 Vol. 156

CONTENTS

	Page
omic Energy	609
ogress in Biochemistry. By Dr. J. H. Quastel, F.R.S.	611
rick Geddes. By R. Brightman	612
nber Resources of Britain. By Major T. H. Hawkins	613
ree-Power Declaration on Atomic Energy	615
tish Anti-Lewisite. By Prof. R. A. Peters, F.R.S., Dr. L. A. Stocken and Dr. R. H. S. Thompson	616
ence and Ethics. By Prof. John A. Ryle	619
ituaries :	
Prof. N. I. Vavilov, For.Mem.R.S. By Dr. S. C. Harland, F.R.S., and Dr. C. D. Darlington, F.R.S.	621
Dr. L. A. Borradaile. By Prof. J. Stanley Gardiner, F.R.S.	622
ws and Views	623
tters to the Editors :	
Need for Development of Tropical Ecological Studies.—Dr. V. J. Chapman, C. O. Flemmich, A. L. Griffith, J. L. Harley, R. Hobbins, C. H. Holmes, C. de Rosayro and J. Wyatt-Smith	627
Mass Departure of Locust Swarms in Relation to Temperature.—Dr. D. L. Gunn, F./O. F. C. Perry, F./Lieut. W. G. Seymour, F./Lieut. T. M. Telford, A.C./2 E. N. Wright and D. Yeo	628
Detection of Birds by Radar.—Lieut. H. A. C. McKay	629
Antimalarial Activity in Tetrahydro-acridones and Related Substances.—Joan M. L. Stephen, Isabel M. Tonkin and James Walker	629
A New Antimalarial Drug.—Isabel M. Tonkin and T. S. Work	630
Effect of some Arylcarbamic Esters and Related Compounds upon Cereals and other Plant Species.—Dr. W. G. Templeman and Dr. W. A. Sexton	630
Crystallization and Identity of the Triose and Triosephosphate Dehydrogenases of Muscle.—Ranwel Caputto and Dr. Malcolm Dixon, F.R.S.	630
Molecular Morphology of Myosin.—Dr. W. F. H. M. Mommaerts	631
Heat Coagulation of Muscle Proteins.—Dr. E. C. Bate-Smith and J. R. Bendall	632
Activity of Helvolic Acid against *Mycobacterium tuberculosis*.—M. A. Jennings	633
A Polysaccharide from *Gigartina stellata* : the Isolation of ‘Crystalline 2 : 6-Dimethyl-*β*-*d*-Galactopyranose from the Methylated Polysaccharide.—Eric T. Dewar and Dr. E. G. V. Percival	633
Resistivity of Thin Metallic Films.—Prof. A. Van Itterbeek and L. De Greve	634
Performance of Diffusion Pumps.—Dr. K. C. D. Hickman	635
Comparative Vacua Produced by Different Oils in a Diffusion Pump.—Kamalesh Ray and Nanda Dulal Sengupta	636
An Illusion of Size.—Prof. H. Hartridge, F.R.S. ; Robert Weil	636
Measurement of Ultrasonic Velocities in Extended Solids.—R. Parshad	637
edel-Crafts Catalysts and Polymerization. By Dr. A. G. Evans	638
pedance Bridge with a 10^9 to 1 Range	639
canological Station of Kamchatka. By S. I. Tomkeieff	640
rganization of Museums in France	641
cent Scientific and Technical Books	Supp. ii

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ATOMIC ENERGY

FROM scientific workers, at least, there will be a warm welcome for the blend of caution and idealism which constitutes the statement on atomic energy issued in London and Washington by President Truman, Mr. Attlee and Mr. Mackenzie King on November 15 as a result of their conversations (see p. 615). Essentially, the statement embodies the conclusions reached by scientific opinion, both among those who have been directly associated with the development of atomic energy and more generally. Most of the ideas that have been put forward for the control of the atomic weapon are included in the terms of reference of the Atomic Energy Commission now to be set up under the United Nations, and in the final article of the statement there is to be sensed something of the urgency and of the overwhelming need for establishing new international machinery or organization, competent to deal with an unprecedented situation which has made some surrender of national sovereignty inescapable if mankind is to avoid disaster.

Too much must not, of course, be claimed for the statement. No decisions have yet been taken : the Commission, which is to work with the utmost dispatch, has first to agree, and agreement may be difficult. The member States of the United Nations will then have power to criticize its recommendations, and there is as yet no certainty that such recommendations will be accepted. Instruments and organizations and schemes alike have yet to be formulated and agreed. None the less, the advance is real and important. So far, the questions of the international inspection of national territories and of the removal of atomic weapons from national armouries have been discussed only by private individuals and groups. They are now to be debated by States, and the offer to abandon their present monopoly, made by the Western Powers, both challenges the temper of the world and makes possible discussion of the whole question in an atmosphere of mutual trust and not intransigence ; it also throws the onus on any who reject the resultant proposals to provide an alternative and acceptable solution.

Whatever may be the outcome of the work of the Commission, the present statement should prove a landmark in science. The affirmation that the fruits of scientific research should be made available to all nations, and that freedom of investigation and free interchange of ideas are essential to the progress of knowledge, marks the public acceptance of a truth that has always been urged in these columns, and of which the making available to the world of the basic scientific information essential to the development of atomic energy for peaceful purposes is only a particular example. The signatories met further to consider the possibility of international action "to promote the use of recent and future advances in scientific knowledge . . . for peaceful and humanitarian purposes". These general declarations must not be overlooked by scientific men, for there are still many obstacles to be overcome in the way of the free flow of scientific knowledge and interchange both of ideas and of workers. They may yet prove of service in widely different fields from that of the possible development of other methods, or of new methods, of warfare which may constitute as great a threat to civilization as the military use of atomic energy.

This contingency is expressly contemplated by the signatories of the statement, which contains no more important passage than that which affirms their intention that all further information of this character that may become available from time to time shall be similarly treated. That step, with the express declaration that the signatories of the statement are willing, as a first contribution, to proceed with the exchange of fundamental scientific information and the interchange of scientific men and scientific literature for peaceful ends with any nation that will fully reciprocate, should go far to create an atmosphere of reciprocal confidence essential to political agreement and co-operation. It is for precisely that reason that some doubts may be entertained as regards the validity of the argument that "specialized information regarding the practical application of atomic energy" should be withheld until such time as "effective, reciprocal and enforceable safeguards, acceptable to all nations" have been devised.

There are two points involved in this argument. The decision to exchange fundamental information is of necessity a general statement; but men of science must be watchful of any attempt to delimit such knowledge for the purpose of instituting a form of censorship. Knowledge is constantly extending its boundaries, and the idea that it is possible to lay down rules for the guidance of an administrative body is most dangerous.

As regards the second point, there is nothing to be gained by haphazard broadcasting of the facts regarding the industrial processes for the atomic bomb, and no objection can reasonably be raised against the intimation in the statement that the United States, Great Britain and Canada are prepared to share such detailed information, on a reciprocal basis, with other of the United Nations when such safeguards against its use for destructive purposes have been devised. That position may not, however, hold indefinitely. Speed in working out the safeguards is vital, and the urge must come from the three signatories of the statement as well as from the other nations in the civilized world to whom the offer is made, and who, as the statement rightly emphasizes, share the responsibility for devising means to ensure that the new discoveries shall be used for the benefit of mankind instead of as a means of destruction.

The United States clearly could not at present go beyond this offer; but scientific workers must see to it that the note of urgency is not lost and that the present decision regarding the industrial information is kept constantly under review. Exceptions, once admitted, are apt to create precedents, and to end by nullifying the principle at stake. Moreover, since the consensus of scientific opinion is that any secrets of the military application of atomic energy—and they may be a chimera—are unlikely to remain secret for any lengthy period of time, the long-term diplomatic drawbacks of secrecy in encouraging warranted suspicion and mistrust may outweigh su temporary advantages as may be thought to der from the present proposal.

From the diplomatic as well as from the scienti point of view, therefore, this aspect of the stateme must be kept carefully under view, and it supplies imperative reason for the Commission completi with the utmost dispatch what are suggested as t first two stages in its task: consideration of the wi exchange of scientific men and information; and t development of full knowledge concerning the natu resources of raw materials. Further, the plan designed to foster the growth of confidence fr actions, and from actions which will engender co fidence through close intercourse. While confiden may be a matter of time, the close intercourse is immediate and vital matter.

A second imperative reason for urgency is to found in the immense potentialities which atom energy offers for the material well-being of mankin Scientific men, while recognizing in the statement t substantial acceptance of their own point of vie must also accept responsibility for seeing that pub opinion recognizes what is at stake, and clear understands both the sacrifices of national sovereign which are involved in any system of internation control, and also the consequences of failure to c operate and to develop an effective scheme. If t precedent of war-time experiment is any guide, t development of atomic energy for industrial a humanitarian purposes will call for the investment very large resources in material, in man-power a in brain-power. Full and swift development will mo assuredly depend on that team-work in scien operating across national frontiers of which the W has given us such remarkable instances.

The statement rightly reminds the world that t responsibility in this matter is one that rests up the whole civilized world, and not on Great Britai the United States and Canada alone. The offer whi they have now made will provide an opportunity f the authorities of the U.S.S.R. to satisfy the desi of Russian scientific workers so conspicuously di played at the recent celebrations of the two hundr and twentieth anniversary of the Academy of Scienc in Moscow to co-operate with their fellows elsewhe If scientific men are to meet and mix freely, and learn to know one another, much will depend how far those of the U.S.S.R. in particular are enabl to co-operate.

Men of science in Great Britain at least will be one in the hope that the work of the new Commissi will give a fresh impetus to co-operation among scie tific workers generally, not merely in the control of t use of atomic energy for destructive purposes, b also in its development for peace-time use, and opening up a new atomic age. Above all, men of goo will everywhere will hope the proposals will give fre reality and purpose to the United Nations Organi tion, and foster the mutual trust and understandi among the nations upon which alone the fulle measure of co-operation is possible even in a task such world-wide scope and significance.

PROGRESS IN BIOCHEMISTRY

dvances in Enzymology and Related Subjects of Biochemistry

lited by F. F. Nord and C. H. Werkman. Vols. 4 and 5.). viii+332; and vii+268. (New York: Interscience iblishers, Inc., 1944 and 1945.) 5.50 dollars each.

THE two volumes under review maintain the high standard of their predecessors. The subjects of e articles are varied, ranging from considerations gene structure to a description of recent work on e biochemistry of Fusaria. There is not an article the two volumes which has not some interest to e biochemist who, in these days of rapid scientific vance, is becoming more and more dependent on equate and authoritative reviews.

The important subject of the structure of the cleoproteins and their connexions with genes and ruses forms the theme of articles by Gulick (vol. 4, 1) and Pirie (vol. 5, p. 1). The former article deals rgely with the subject of chemical genetics and ves a number of interesting examples of the manner which mutations occur with loss of specific chemical nctions. For example, a strain of *Neurospora* exists nich differs from the normal in its inability to syn- esize the thiazole component of aneurin (vitamin), another exists which cannot synthesize pyrid- ine (vitamin B_6) and yet another which cannot nthesize the *p*-aminobenzoic acid which it requires. pparently the last strain has lost an enzyme which concerned with the introduction of an amino group to the para position of the benzene nucleus. Other stances, concerned with the occurrence of pigments plants or of colours in insect eyes or of melanins mammalian hair, are quoted. Two examples of herited chemical anomalies in man are touched on—these are cystinuria, a congenital defect be- ving as a Mendelian recessive, and hæmophilia. he author might well have included phenyl- tonuria, a condition associated with mental defect, which phenylpyruvic acid is excreted in the urine. hese conditions of abnormal metabolism are in- cators of the parts played by the genes in estab- hing the chemical character of a living cell. Little at is definite is known of the chemical structure of nes but presumably they have the properties of cleoproteins, aggregates of which form the romosomes on or in which the genes are situated. ny gene must have the property of self-reduplication sides its power of producing in the cell the enzymic aterial or systems which characterizes the gene. It ems probable that there is much in common be- veen the gene and the virus, the physical and chem- al properties of which form the subject of the article Pirie. The latter deals in particular with tomato ishy stunt virus and strains of tobacco mosaic virus. uch is now known of these substances, which have en crystallized and analysed and which "have ecial advantages as materials for the study of the emical and physical behaviour of proteins, for they ve an unusually large number of properties that e well adapted for the quantitative study of the anges" which they undergo.

The properties of enzymes form the subjects of ticles by Pigman on the glycosidases (vol. 4, p. 41), Nelson and Dawson on tyrosinase (vol. 4, p. 99), d by Blaschko on amino-acid decarboxylases ol. 5, p. 67). Pigman gives a comprehensive survey recent contributions on the mechanism of action glycosidases with special reference to the work Helferich and his associates on the action of β-glucosidase of almond emulsin on aryl and alkyl β-glycosides. This work provides an interesting study of the influence of structure on the rate of a chemical reaction controlled by an enzyme. Pigman also introduces in his article a useful classification of the carbohydrases. The enzyme tyrosinase has now a comparatively large literature devoted to it. It has played an important part in the development of modern views of the mechanism of biological oxidations, for although Bertrand first described it in 1896, interest in the chemistry of the oxidases dates back to the classical work of Schonbein in 1856. Nelson and Dawson ably summarize present knowledge of tyrosinase as a catalyst of the aerobic oxidations of both monohydric and *o*-dihydric phenols and discuss the question as to whether the enzyme is a single protein having two distinct activities or whether it is a mixture of two distinct proteins having different chemical activities. They finally conclude that it is a single copper protein entity having two enzymic activities. Blaschko deals, in his article, with amino-acid decarboxylases of mammalian origin, pointing out their importance in the body in the elaboration of histamine, adrenaline and taurine. It will be of interest to discover whether mammalian amino-acid decarboxylation depends on the presence of phospho-pyridoxal, as is now known to be the case with bacterial amino-acid decarboxylases.

The reversible intermolecular transfer of an amino group from an α-amino-acid to an α-keto-acid, now known as transamination, forms the theme of an article by Herbst (vol. 4, p. 75). This author deals first with transamination in model systems and then with enzyme catalysed systems, paying attention to the pioneer work of Braunstein and Kritsman and to the later work of Cohen on the kinetics of transaminase activity in tissue extracts. It is of interest that those substances which are most actively transaminated (*l*-glutamic acid, oxalacetic acid, pyruvic acid) hold key positions in carbohydrate and amino-acid metabolism, the kinetics of which, therefore, may in certain circumstances be controlled by the presence of transaminases.

One of the most striking advances in recent years has been the discovery and exploration of the natural antibiotics, of which penicillin is the most spectacular example. Hotchkiss (vol. 4, p. 153) contributes an article on gramicidin, tyrocidine and tyrothricin which is of the greatest interest in presenting information on the properties and possible modes of action of these substances. Dubos in 1939 described the preparation from cultures of an ærobic spore-forming organism (*B. brevis*) of a protein-free product having highly antibacterial properties. This product, termed tyrothricin, was separated by crystallization into two alcohol-soluble polypeptides, gramicidin and tyrocidine. Gramicidin and tyrothricin in very small quantities prevent the development of a variety of Gram-positive micro-organisms *in vitro* and under some conditions *in vivo*. Tyrocidine also kills Gram-positive and Gram-negative bacteria *in vitro* but not in the presence of serum proteins. Tyrothricin has been found to modify the course of infections in man and animals, but it is too toxic to the host to have more than a limited application. Gramicidin and tyrocidine have molecular weights about 3,000 and seem to contain a large proportion of *d*- or unnatural amino-acids. Hotchkiss presents evidence in support of the view that gramicidin may exert its bacteriostatic effects by blocking a metabolic process involving the uptake of phosphate and thus interfering with the cell's normal synthetic operations. It has pronounced effects on the metabolism of susceptible bacteria when these are examined in the form of washed suspensions. Tyrocidine is bactericidal in action, bringing about a release of soluble cell constituents from the susceptible bacteria. The evidence indicates that, apparently, tyrocidine "so modifies the cell surface that vital soluble metabolites such as nitrogen compounds, inorganic phosphate and phosphate esters are washed out of the cell". The results illustrate the variety of ways in which antibiotics may affect susceptible cells, by interference with processes essential to normal metabolism or by modification of physical conditions whereby the cell equilibria are upset.

Jensen and Tenenbaum give a brief account (vol. 4, p. 257) of recent work on the influence of hormones on the enzymic activities of various tissue preparations. The hormones dealt with include those of the pituitary group, insulin, thyroid, epinephrine and those of the adrenal cortex. There is no information as yet on the possible role of these hormones in specific enzyme processes and no evidence has been obtained that they themselves are enzymes or essential components of enzyme systems. They affect the courses of enzyme regulated reactions apparently only in the intact cell or in the body.

The influence of nicotinamide on enzyme reactions forms the subject of a comprehensive article by Schlenk (vol. 5, p. 207). Nicotinamide sprang into prominence in 1934 when it was discovered by Warburg and Christian, and by Euler, Albers and Schlenk, that it was a constituent of coenzymes essential for the activity of certain dehydrogenase systems. Two years later, Kohn and Elvehjem prepared a liver concentrate which cured chick dermatitis and dog black tongue. Elvehjem and his colleagues then isolated nicotinamide from the concentrate and showed that nicotinic acid administration would cure black tongue. Thus the discovery of the vitamin activity of nicotinic acid followed the finding that it is an essential constituent, in the cell, of respiratory processes. It is now generally held that the biological importance of nicotinic acid lies in its necessity for the building up in the body of coenzymes of dehydrogenases. Schlenk describes the results of work carried out on the structure and properties of the nicotinamide nucleotides, and on their mode of action as coenzymes. He describes methods for their quantitative determination and he also summarizes recent work on the interference of carcinogenic products with dehydrogenase activities. He deals with investigations on the fate of nicotinic acid in the body, on the enzymic breakdown of the nicotinamide dinucleotides, and on the specific inhibitive action of nicotinamide on this breakdown.

The central role of pyruvic acid in cell metabolism is the theme of an article by Stotz (vol. 5, p. 129), who considers recent advances in pyruvate metabolism. Stotz deals with the wealth of data accumulated on this subject (he cites 221 references) and discusses the part played by pyruvate in glucolysis, and by the various dehydrogenases and phosphorylating systems involved. He describes work on pyruvate dismutation, decarboxylation, oxidation and condensation, processes all requiring the presence of diphosphoaneurine (vitamin B_1) and on the parts played by pyruvate in acetylcholine synthesis in brain, in carbon dioxide fixation in bacteria and animal tissues, in transaminations, and in fatty acid metabolism. Pyruvate occupies a key position most of the important phases of cell metabolis bearing out a thesis put forward by the review more than twenty years ago[1] that pyruvate may w be considered a primary metabolite, a substan which occupies an essential role in the synthet operations of the cell.

Potter contributes a most interesting and thoug ful article (vol. 4, p. 201) on biological energy tran formations, discussing details of glycolytic, oxidati and phosphorylative mechanisms. He includes ve useful data on the methods of analysis used in t study of these mechanisms, and gives tables of ass results in tissues, with particular reference to co ponents of the succinoxidase system, to adenosinet phosphatase, to coenzymes of dehydrogenases and riboflavin. He discusses the subject in relation the metabolism of tumours.

While there is an inevitable overlap between t articles, dealing with cell metabolism, of a number the contributors to the volumes under review, th constitutes, in the reviewer's opinion, no demer Knowledge of the details of cell metabolism is e panding so rapidly that only good can come from t presentation of different points of view, even thou much common ground is covered by the exponen of these views.

Leibowitz and Hestrin (vol. 5, p. 87) discuss t question of the fermentation of the oligosaccharid (for example, maltose, sucrose and lactose) as distin from that of the breakdown of polysaccharides (su as starch and glycogen). They deal in a detailed w with the indirect fermentation theory of Fischer a the direct fermentation theory of Willstätter, a assemble the evidence bearing on the mechanism the fermentation of the oligosaccharides with speci reference to the parts played by phosphorylati mechanisms. They deal also with the interesti syntheses of polysaccharides (levan and dextran) fro sucrose by soluble cell-free enzyme obtained fro bacteria.

Limitation of space alone prevents more th mention of the instructive article by Nord and M on recent progress in the biochemistry of Fusa (vol. 5, p. 165), of the account of the chemistry of t coagulation of blood (vol. 5, p. 31) by Chargaff w has contributed so much to this subject, of t description of a number of enzymic processes co cerned with the metabolism of sulphur compoun (particularly cysteine and methionine) by Smyt (vol. 5, p. 237), and finally of the useful article Brode (vol. 4, p. 269) on the absorption spectra vitamins, hormones and other biologically importa substances.

J. H. QUASTEL.

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[1] *Biochem. J.*, 19, 641 (1925).

PATRICK GEDDES

Patrick Geddes

Maker of the Future. By Philip Boardman. Pp. xix 504+13 plates. (Chapel Hill, N.C.: University North Carolina Press; London: Chapman and Ha Ltd., 1944.) 30*s*. net.

IN so much as Mr. Boardman succeeds in conveyi a vivid picture of Geddes' dynamic personalit the wide sweep of his interests, and to some exte of the contribution which Geddes made as a teach as a pioneer in sociology and as a creative thinker town and regional planning, he may be held to ha cceeded in his purpose. Patrick Geddes is probably ost widely known as the joint author with J. Arthur omson of "The Evolution of Sex" and "Outlines General Biology", and Mr. Boardman's study ould indicate to a fresh generation something of e vitality, the stern common sense and realism, the eadth of scholarship which marked Geddes in his nderings as student or as professor, and brought m into more creative enterprises than any other n in the three decades preceding the outbreak of e War of 1914–18. His adventurous spirit stands t afresh from these pages, and the appeal of the ok to youth is enhanced by the picture of his oneer enterprise in starting a students' hall of sidence at the University of Edinburgh or of his bsequent contribution to the renovation of Edin- rgh Old Town. Prof. Geddes' services in adult ucation, as an apostle of town-planning and the doubted parent of the regional survey, his un- asing warfare on specialization, all find a place, ough one would not draw from this book quite the pression of Geddes as inspiring a new and creative nception of social service to which Mumford paid bute in "The Condition of Man".

But it is essentially a portrait rather than an terpretation that Mr. Boardman gives us, and the cord of the stages and the manner in which the ung scholar of Perth Academy and the student der Huxley at the Royal School of Mines battled s way to the chair of botany at University College, undee, might well be clearer in places. Somewhat nfused, too, is the record of the myriad activities, ch as the civic surveys of Dunfermline and Dublin, s direction of "The Masque of Learning" in London d Edinburgh, his influence on the Town Planning nference Exhibition in London in 1910, the Indore port on Town Planning and on university reform, hich he pursued for thirty-one years from that chorage. The relevance of those activities and eas, especially in education and in the field of uversity reform, to current discussions is obvious, d there is much in the book that is stimulating d suggestive—not the least in the finely sketched cture of Geddes' relations with his son Alasdair d the demonstration of the practical value of his ucational theories.

When all that is said, the book, admirably pro- ced and printed though it is, is somewhat dis- pointing. Within the compass of five hundred ges, one expects something more substantial, and e perceptive preface contributed by Mr. Lewis umford, himself a distinguished American disciple Geddes, cannot redeem the deficiencies of scholar- ip or critical appraisal of the significance of Geddes' e and thought and his influence on education or on gional planning. It is not sufficient for Mr. Board- an to disclaim any pretensions to a definitive ography: his skill and industry in reducing to the esent limits the scattered, imperfect and almost manageable records of a remarkable career call ly for admiration; but having done so much, Mr. ardman should not have been content merely to cord this constant interpenetration of the general d the particular, the philosophical and the scientific tlook, the universal and regional which character- ed Geddes, and late in life tended to engender redom.

The real defect of what purports to be a serious udy is not, however, this lack of scholarship—and it noted we have here yet another expensively oduced book shorn of the few pages necessary to supply complete bibliographical information—it is a defect of technique. Fiction has its place in the imaginative interpretation of history, as Margaret Irwin, for example, has shown; and there will always be readers to whom the picture of Montrose will be conveyed more effectively through the medium of such a book as "The Proud Servant" than in such a brilliant study as John Buchan's "Montrose". Both methods have their place, but that place is not in the same book, and Mr. Boardman's fatal mistake in this volume has been the combination of fictional and straightforward biographical technique. Whatever picturesqueness his lapses into fiction may introduce, they confuse the narrative. It is unfortunate that Mr. Boardman should have been tempted into the use of a device which mars a serious study.

R. BRIGHTMAN.

TIMBER RESOURCES OF BRITAIN

The Wood from the Trees

By Richard Jefferies. (London: The Pilot Press, Ltd., 1945.) Pp. 143+16 plates. 9s. 6d. net.

THE contents of this book can be briefly stated. There are three clearly defined sections, the first of which deals with the main forest resources of the world, the methods of preparing timber, and the pre-war and possible post-war flow of timber from exporting countries to Great Britain. In the second section Jefferies describes the role and uses of timber as an implement of war and speculates about the probable fate of timber resources in invaded and other countries. Despite the author's real interest in the uses, distribution and potential value of wood, however, it is clearly apparent that the theme and the *raison d'être* of this book lie in the third section.

Here the *motif* is the imperative necessity for the greater development of timber resources in Great Britain. This is repeatedly brought out and might have gained greater emphasis if it had been stated once or twice less often. One reason for the previous neglect of our trees, declares the author, is that private owners have hitherto not realized the true value of wood. Since the State also has not been particularly diligent in its afforestation programmes, we have been faced by two wars in an unprepared condition and have had to divert considerable shipping space to bring in a bulky commodity, much of which could have been grown at home. Therefore, continues Jefferies, who is no doctrinaire politician, neglected forests of Great Britain must be taken over by the State and become part of a planned forestry programme. Besides already existing woodlands, schemes of afforestation should be drawn up for the several million acres of rough grazings which are not specially favourable for agricultural development. All this, and much more, is persuasively argued, and, even if it fails to influence Government policy, should at least stimulate some owners of private forests to put their wood in order.

"The Wood from the Trees" would have carried greater weight, however, if, in addition to his plea for home-produced timber, Jefferies had been more revealing about the kind of trees he advocated and the relative amounts and geographical distribution of hardwood and softwood he would grow and his reasons for so doing. The book is attractively finished with clear and relevant photographs and some helpful 'isotype' diagrams; no reason is given for the absence of an index.

T. H. HAWKINS.

Science and the Planned State

By John R. Baker. Pp. xvi+102. (London: George Allen and Unwin, Ltd., 1945.) 7s. 6d. net.

THIS volume purports to give a careful analysis and criticism of the totalitarian view of science. Considering first the proposition that science exists only to serve the material wants of man, upon which he suggests that the whole of the totalitarian view of science is based, Dr. J. R. Baker proceeds to discuss the 'freedoms' which best serve the cause of discovery. He then deals briefly with science under totalitarianism, but more particularly with science in the U.S.S.R., the deficiencies of Soviet science and the genetics controversy, and in his last chapter on the duties of scientific men to society endeavours to indicate some of the ways in which they may use their special talents for the benefit of others. As in his book, "The Scientific Life", Dr. Baker insists on the importance of the element of chance in scientific discovery and the encouragement of the amateur. In dealing with such a topical subject, it would be strange if Dr. Baker had not something pertinent and suggestive to say, and this fresh plea for the preservation of freedom of inquiry, for valid argument and insistence on the cultural value of science is to be welcomed.

None the less, this is scarcely a book which will add to Dr. Baker's reputation. It cannot be claimed that he brings to his task the objectivity that should characterize the scientific man. He consistently fails to distinguish between the planning of discovery, which is manifestly absurd, and planning the general manner in which available scientific resources should be used. Dr. Baker is inclined not to see the facts that are uncomfortable or disconcerting for his theory, and the real contribution of his book to the debate on the planning of science is slight, however unexceptionally it maintains that science does not exist solely to serve man's material needs, that a thorough-going scheme for the central planning of research would gravely damage science or that totalitarianism is the form of government least in accord with scientific principles. Nor does Dr. Baker strengthen his argument when, for example, he quotes A. Szent-Györgyi second-hand from the *World Digest*, or the Archbishop of Canterbury from the *Sunday Express*. Finally, the numbering of the references in alphabetical sequence at the end of the volume, even though it has the authority of Royal Society practice in biological papers, instead of in numerical sequence as they occur, cannot be allowed to pass without protest from at least one reader.

Metallography of Magnesium and its Alloys

A translation from the German by the Technical Staffs of F. A. Hughes and Co., Ltd., and Magnesium Elektron, Ltd., of "Metallographie des Magnesiums und seiner technischen Legierungen", by Walter Bulian and Eberhard Fahrenhorst. Pp. xi+117. (London: F. A. Hughes and Co., Ltd., 1944.) 15s.

MESSRS. F. A. Hughes and Co. and Magnesium Elektron, Ltd., have already placed the metallurgical world deeply in their debt by their excellent translation of Beck's "Technology of Magnesium and its Alloys". They have now increased that debt by translating another German book dealing with a much narrower part of the magnesium field: Bulian and Fahrenhorst's "Metallographie des Magnesium und seiner technischen Legierungen". In one respect this translation differs from that of the earlier bo a very valuable feature of which was that footnot correcting errors of statement, important omissi or biased points of view, were freely added to the te Perhaps it is a pity that this has not been done the translation under review; but it must be mitted that such notes are not nearly so needed i book like the present one, which is written aroun series of photographs, whereas in Beck's book personal opinion and bias of the writer had mu more play.

The book commences with a chapter on polishi and etching technique and then reproduces 2 photomicrographs and 10 macrographs, which their high level of excellence confirm the value of t technique described. They are well selected illustrate the different types of structures which described in the text. A useful bibliography bri to a close this book, which can be confidently reco mended to all who have to deal with the microscop examination of magnesium alloys.

Through My Garden Gate

By Newman Flower. Pp. v+94. (London, Toront Sydney and Melbourne: Cassell and Co., Ltd., 194 5s. net.

THIS is a delightful book, well worthy of noti in a scientific journal, because the man of scien like all other sensible men, may know the sim pleasure of working in and enjoying his garden. T book is a collection of garden observations, "though and philosophy by a keen amateur gardener of ma years standing". He describes "the garden of thousand joys", which, he says, is the only na for the garden which is loved by the person w works in it. He does not write for the wealthy pers who owns a garden in which the work is done by ag menials, nor for a gardening mechanic who mere makes a garden. He writes for those for whom garden means what it means for him—a belov place where one toils and plants one's thoughts. H book is one which can be picked up at any tin for through its pages runs a warm and a high intelligent love for the things of the garden.

The Statesman's Year Book

Statistical and Historical Annual of the States of t World for the Year 1945. Edited by Dr. M. Epste Eighty-second annual publication, revised af Official Returns. Pp. xxxvi+1479. (Londo Macmillan and Co., Ltd., 1945.) 30s. net.

THIS indispensable annual again makes regular appearance with revision up to the e of the first quarter of the year. The end of the W in Europe came too late for inclusion in the histori summaries and so, for the last time, Germa appears in her pre-war state and with her N leaders. Revision in war-time is far from easy, many States have published no statistical retur of production and trade. Wherever possible, ho ever, recent figures in many parts of the Emp and in the United States have been included. T invaluable bibliographies attached to each secti have been thoroughly revised and in some ca extended. This is specially noteworthy in regard the United States. Two coloured maps show spectively the Russo-Finnish boundary of armistice of 1944 and world airways for internatio transport. The volume retains its usual size a compact form.

THREE-POWER DECLARATION ON ATOMIC ENERGY

THE statement on the future use of atomic energy, prepared after consultations held in 'ashington between the President of the United ates and the Prime Ministers of Canada and the nited Kingdom, was read at the White House and the House of Lords and the House of Commons on November 15. The text is as follows :

The President of the United States, the Prime inister of the United Kingdom, and the Prime inister of Canada have issued the following statement :

1. We recognize that the application of recent ientific discoveries to the methods and practice of ar has placed at the disposal of mankind means of estruction hitherto unknown, against which there an be no adequate military defence, and in the employment of which no single nation can in fact have monopoly.

2. We desire to emphasize that the responsibility or devising means to ensure that the new discoveries hall be used for the benefit of mankind, instead of a means of destruction, rests not on our nations lone, but upon the whole civilized world. Nevertheless, the progress that we have made in the development and use of atomic energy demands that we ake an initiative in the matter, and we have accordingly met together to consider the possibility of iternational action :

(*a*) To prevent the use of atomic energy for destructive purposes.

(*b*) To promote the use of recent and future advances in scientific knowledge, particularly in the tilization of atomic energy, for peaceful and humanarian ends.

3. We are aware that the only complete protection for the civilized world from the destructive se of scientific knowledge lies in the prevention of ar. No system of safeguards that can be devised ill of itself provide an effective guarantee against roduction of atomic weapons by a nation bent on aggression, particularly since the military exploitation of atomic energy depends, in large part, upon the same weapons and processes as would be required for industrial uses. Nor can we ignore the ossibility of the development of other methods or f new methods of warfare, which may constitute as great a threat to civilization as the military use of atomic energy.

4. Representing, as we do, the three countries which possess the knowledge essential to the use of tomic energy, we declare at the outset our willingness, as a first contribution, to proceed with the xchange of fundamental scientific information ; and the interchange of scientists and scientific literature or peaceful ends with any nation that will fully eciprocate.

5. We believe that the fruits of scientific research hould be made available to all nations, and that reedom of investigation and free interchange of deas are essential to the progress of knowledge. In pursuance of this policy, the basic scientific information ssential to the development of atomic energy for peaceful purposes has already been made available to the world. It is our intention that all further information f this character that may become available from me to time shall be similarly treated. We trust hat other nations will adopt the same policy, thereby creating an atmosphere of reciprocal confidence in which political agreement and co-operation will flourish.

6. We have considered the question of the disclosure of detailed information concerning the practical industrial application of atomic energy. The military exploitation of atomic energy depends, in large part, upon the same methods and processes as would be required for industrial uses. We are not convinced that the spreading of the specialized information regarding the practical application of atomic energy, before it is possible to devise effective, reciprocal, and enforceable safeguards acceptable to all nations, would contribute to a constructive solution of the problem of the atomic bomb. On the contrary we think it might have the opposite effect. We are, however, prepared to share, on a reciprocal basis with other of the United Nations, detailed information concerning the practical industrial application of atomic energy just as soon as effective enforceable safeguards against its use for destructive purposes can be devised.

7. In order to attain the most effective means of entirely eliminating the use of atomic energy for destructive purposes and promoting its widest use for industrial and humanitarian purposes, we are of the opinion that at the earliest practicable date a commission should be set up under the United Nations to prepare recommendations for submission to the organization. The commission should be instructed to proceed with the utmost dispatch and should be authorized to submit recommendations from time to time dealing with separate phases of its work.

In particular, the commission should make specific proposals :

(*a*) For extending between all nations the exchange of basic scientific information for peaceful ends.

(*b*) For control of atomic energy to the extent necessary to ensure its use only for peaceful purposes.

(*c*) For the elimination from national armaments of atomic weapons and of all other major weapons adaptable to mass destruction.

(*d*) For effective safeguards by way of inspection and other means to protect complying States against the hazards of violations and evasions.

8. The work of the commission should proceed by separate stages, the successful completion of each of which will develop the necessary confidence of the world before the next stage is undertaken. Specifically, it is considered that the commission might well devote its attention first to the wide exchange of scientists and scientific information, and as a second stage to the development of full knowledge concerning natural resources of raw materials.

9. Faced with the terrible realities of the application of science to destruction, every nation will realize more urgently than before the overwhelming need to maintain the rule of law among nations and to banish the scourge of war from the earth. This can only be brought about by giving wholehearted support to the United Nations Organisation, and by consolidating and extending its authority, thus creating conditions of mutual trust in which all peoples will be free to devote themselves to the arts of peace. It is our firm resolve to work without reservation to achieve these ends.

BRITISH ANTI-LEWISITE (*BAL*)

By Prof. R. A. PETERS, F.R.S., Dr. L. A. STOCKEN AND Dr. R. H. S. THOMPSON

Department of Biochemistry, University Museum, Oxford

IN the first fortnight of the War (1939) fundamental research was initiated in the Oxford Department of Biochemistry by Peters and carried out under his direction by a group of workers as an extra-mural research with the support of and for the Chemical Defence Research Department, Ministry of Supply; the object was to find antidotes for vesicants, both arsenical such as lewisite ($CH.Cl : CH.As.Cl_2$) and also those of the mustard gas type. In this brief review, the main facts are given about the discovery of the antidote to lewisite known as *BAL*, owing to its medical importance; more detailed papers based upon the original reports are being prepared. An attempt is made to include the more relevant work from elsewhere and also to focus the main stages in this discovery, as this may prove useful in planning future work of this type.

Research upon the biochemical lesion in aneurin (thiamin) deficiency especially in Oxford had established that serious pathological change in the brain was induced by a partial failure of an enzyme system, the 'pyruvate oxidase', due to deficiency of an essential component, aneurin pyrophosphate (cocarboxylase)[1]. In 1936, Peters[2] reported that the vesicant substance dichlordiethylsulphone had a selective action upon the enzyme system oxidizing lactate in brain, poisoning the pyruvate component, like the enzyme inhibitor iodoacetic acid; since the latter is a weak vesicant, he suggested that the similar vesicant effect of the two substances might be related to this action. He also found that sodium arsenite in very small concentrations gave a like effect[3]; it had been known previously that oxidations were poisoned by arsenite[4] and especially α keto acid oxidations[5]. These observations focused attention upon the possibility that partial failure of an enzyme could be directly responsible for the pathological change and suggested which enzyme this might be.

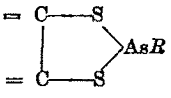
Another line of thought came from much earlier work in 1923–26 carried out in this laboratory by E. Walker under the direction of Peters with the object of throwing light upon the fundamental problem of chemical constitution and toxicity of chemical warfare agents in extension of earlier work at Porton[6] and of gaining thereby therapeutic advances. Arising out of the stimulus due to Hopkins' discovery of glutathione, arsenicals such as diphenylchlorarsine were found to abolish the fixed —SH in washed muscle tissue[7] and also in the active layer of skin; hence there was interference in glutathione catalysis[8]. As the —SH reaction could not be restored by cyanide treatment[9], chemical combination (rather than oxidation) was suggested. Though for security reasons this work was only published in part in 1928[10], it was in progress independently and about the same time as that of Voegtlin and his colleagues (1923–25)[11], who advanced the view that the toxic action of arsenic on living cells was due to its reaction with certain essential thiol compounds present in protoplasm. Together with their work upon the therapeutic arsenicals, ample reason was given for directing attention to —SH groups as possible receptors arsenic, an emphasis which was strengthened work in subsequent years, for example, especia Rosenthal[12]. These ideas were also reinforced by proofs[13] that iodoacetate readily combined with — compounds and suggested the hypothesis that arse poisoned an —SH component of the enzyme. A furt most important point was supplied by Cohen, Ki and Strangeways[14], when they showed that th arsinites of type $R\,\mathrm{As}(SR^1)_2$ were dissociable alkaline solution, because this gave grounds for belief that reversal of the toxicity might pro possible.

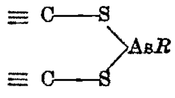
Hence the idea that the activity of arsenicals due to a selective action upon the pyruvate enzy- system and that some essential —SH component attacked formed the starting point of the resear for an antidote to lewisite. Owing to the rapidi with which substituted chlorarsines are hydrolys it was natural to consider that the effects of arseni vesicants on the skin are special examples of general action of arsenoxides upon living cells; vesicant action would be conditioned by the lipo solubility of the chlorarsines which allows them penetrate the keratin layer and so reach the cells the epidermis, dermis and capillaries.

Early in the War, fresh work by Peters, Sincl and Thompson[15] supported the idea of a selecti action of sodium arsenite and of lewisite on enzym and of their powerful action on the pyruvate syste since 50 per cent inhibition of the activity was pr duced by concentrations of 15 × 10^{-6} *M* (abo 100 µgm/gm. brain brei). Some other enzymes su as succinodehydrogenase were much less strong affected, if at all. *In vivo*, also, it was proved th poisoning with arsenite led to an elevation of blood pyruvate level, confirming that the oxidati of carbohydrate was powerfully poisoned at pyruvate stage. This was entirely analogous to raised blood pyruvate levels in thiamine deficiency but with the difference that the missing active co stituent was the protein: the coenzymes withsto the poison[17]. All this proved that the pyruva oxidase system could be confidently used as an *vitro* test for the exploration of the problem, a throughout the work it fully justified this beli Evidence[18] was soon forthcoming that an —SH gro was essential for its activity, confirming a previo guess.

In spite of these indications, in enzyme and anim tests carried out by Sinclair[19] early in 1940 no mon thiol compound, or dithio compound (such as dieth dithiocarbamate) was effective, even protectivel against lewisite or arsenite. This applied indeed glutathione, which in large excess had been sho by Voegtlin and colleagues and Eagle[20] to sh activity against therapeutic arsenoxides. Again mo puzzling of all, as in Strangeway's experiments[21], t compounds of arsenicals with thiols could be as tox as the original arsenical; this point was stressed wi fresh evidence by Ing and Robinson[22] and can nev be safely overlooked in dealing with the behavio of new thioarsinites *in vivo*. At this stage the possib lines of progress seemed narrow; they were, perha more systematic trial of other thiols without furth biochemical guidance; and a study of the relati dissociation of various thioarsinites, often urged Philpot; neither of these lines was followed the because Stocken and Thompson started to g further information upon the interaction of th groups in proteins by analysis of compounds onic with an —SH protein product, partly for the damental study and partly to provide useful pre- inary information for examining the immuno- ical behaviour of arsenical proteins. The experi- nts were analogous to Rosenthal's, but differed in protein used and in their analysis of its arsenic l —SH content. This stage proved crucial and led a logical solution of the problem.

After treating aqueous solutions of kerateine, the uced product of keratin, containing many —SH ups[23] (the only protein of high thiol content then essible) with lewisite under physiological condi- ns of temperature and pH, Stocken and Thompson und that the arsenic content of the lewisite-kera- ne compound could be correlated rather closely th the thiol content of the parent protein, being lependent of the concentration of lewisite above a iting value[24]. This compound was stable on lysis. Oxidation of the —SH groups to the S—S— form (metakeratin) before treatment with isite led to large reduction in the amounts of enic combined. It was highly significant that in ite of large excess of lewisite, 75 per cent of the enic found in the lewisite compound was in com- ation with two thiol groups. This fact together th the ease of re-oxidation of the kerateine to the ulphide form led them to the hypothesis that the h toxicity of lewisite and of trivalent arsenicals in neral was due to their ability to combine with the ential —SH groups in certain tissue proteins, tably the enzyme concerned, to form stable enical rings. On chemical grounds compounds of pe I would be expected to be more stable than mpounds of an arsenical with two molecules of a onothiol of Type II.

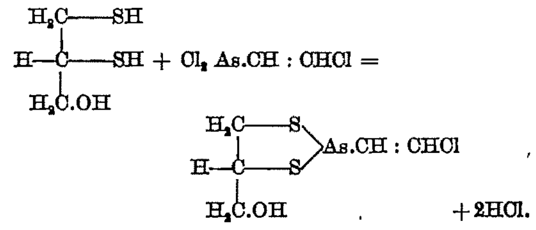
I


II


Hence simple dithiol compounds might form atively stable ring compounds with lewisite or her trivalent arsenicals and so compete successfully th 'dithiol' proteins in the tissues. In this case ioarsinites formed with monothiols would dissociate as to let their arsenic combine in ring formation th tissue thiol; this in its turn might be slightly ore dissociable than the ring formed with simple thiols. (Experimental evidence for this was pro- iced later by comparing relative rates of hydrolysis different types of thioarsinites and of lewisite- rateine[25].)

Antidote Activity of Simple Dithiols

The study of therapeutic possibilities began in 1940 th an investigation of simple small molecular 1 : 2 d 1 : 3 dithiols (Stocken and Thompson). (It may mentioned that in a related research it had been und by Philpot that small molecular fatty acids netrated the skin much more readily than long- ain compounds.) First to be tested was toluene hiol (the B.D.H. spot reagent) with promising sults on the enzyme, followed by ethane dithiol. ither of these compounds proved really suitable the objective of skin treatment and the new com- und 2 : 3 dimercaptopropanol (III) was made; as is was a penetrant oil it proved very satisfactory. the pure state it is about 6 per cent soluble in ter. The reaction with lewisite is :

III


This 'dithiol', to which the name *BAL* (British anti-lewisite) was given by the Americans, proved highly effective in stopping the toxic action of lewisite upon the pyruvate oxidase system in brain. Unlike all other thiol compounds tried, concentrations of 10^{-1}mM *BAL* gave almost complete protection against the 50 per cent inhibition of enzymatic activity produced by 15 μM lewisite oxide under these conditions.

A further most important point was now established: *BAL* could reverse the toxic action as well as prevent it, provided that the toxicity had not been too long established. It could also neutralize the lewisite inhibition of skin respiration. None of these effects was produced by monothioethylene glycol or by cysteine in equivalent concentrations. Later experiments confirmed the hypothesis that the cyclic thioarsinites were less toxic than lewisite and non-cyclic thioarsinites by showing that the toxicity of lewisite was much more reduced by combination with *BAL* than with monothioethylene glycol[25].

Treatment of Arsenical Burns with Dithiol Compounds

In agreement with the *in vitro* biochemical tests, rats and guinea pigs contaminated with lewisite could be saved by inunction with *BAL* (and also by injection of aqueous solutions of *BAL*) up to periods of two hours after contamination at a time when the animals are seriously ill. Finally, tests upon human volunteers contaminated with lewisite carried out both at Oxford[26] and Porton[27] showed that vesication by lewisite and by phenyldichlorarsine can be prevented by the application of *BAL* as late as one hour after contamination, that is, at a time when well-marked signs of injury to the skin (erythema and œdema) had developed. In many cases the residual erythema twenty-four hours after treatment was considerably less both in size and intensity than that already present at the time of treatment; in some of the experiments the subsidence of the skin oedema following treatment was sufficiently rapid to suggest an actual reversal of the underlying pathological change brought about by the lewisite. In contrast to these results with *BAL*, both in rats and in human tests, monothioethylene glycol did not influence the severity of vesication. These results have been confirmed many times, and extended in the United States and in Canada. It has been shown in Oxford by Mann and Pirie, at Porton[28] and also in the United States[29] that *BAL* suitably administered will prevent the destruction of a rabbit's eye up to periods of twenty minutes after contamination. Much effort and time has been expended both in Great Britain[30] and in the United States[31] in the preparation of satisfactory ointments, the details of which lie outside the scope of this review; this work forms a valuable basis for inunction treatment.

Practically all the above facts are contained in reports presented to the Ministry of Supply in 1940, 1941 and 1942[32]. Several other facts about *BAL* were also discovered at this time. *BAL* treatment of lewisite burns in rats was followed by a marked increase in the elimination of arsenic in the urine during the succeeding twenty-four hours, even when treatment with *BAL* is delayed for one hour after contamination, and when systemic toxic signs are already present. (Results confirming and extending this were reported by Graham and Chance, Edinburgh (1944)[46a] and by Zbarsky, Monson and Young in Canada in 1944.) Fæcal excretion of arsenic was not significantly affected. The severe diarrhœa invariably present in the untreated rats was completely prevented. Analysis of the excised skin showed a reduction in the amount of arsenic present in the contaminated area (confirmed by Chance[46b]). An unidentified thiol was rapidly excreted in the urine of rats and rabbits after subcutaneous injection of *BAL*.

Small amounts of *BAL* placed upon the skin produced in human subjects an erythema persisting for two hours, and in the case where 1 c.c. of *BAL* was rubbed into the human forearm, there was also lacrymation. These effects were transient, but repeated application of *BAL* can produce sensitivity[33]. By subcutaneous injection in rats, *BAL* had a toxicity of about 110 mgm./kilo (LD 50); this work was extended by Gaddum and Boyland; a reference standard *BAL* has been prepared in Oxford[34].

Fell and Allsopp (1941)[35] found that tissue cultures severely poisoned with lewisite largely recover when treated with *BAL*, thereby showing direct antidote effects upon cells (their findings have been confirmed and extended by Harrison and Randoll[36]). Further studies upon enzymes at Cambridge and in the United States[37], and at Oxford[38] by Stocken, Thompson and Whittaker, have shown that enzymes in tissues and isolated enzymes are protected by *BAL* from the toxic effects of lewisite and arsenicals; in the work by Van Heyningen hexokinase poisoning by lewisite was reversed by glutathione as well as by *BAL*, whereas pyrophosphatase and succinic dehydrogenase responded only to the dithiol. Enzyme studies on the nature of *BAL* inhibition have also been made by Webb and Van Heyningen under Dr. M. Dixon and in the United States; the former consider that *BAL* inhibits specifically enzymes containing metals, owing to its high affinity for them.

Pharmacological and pathological work upon *BAL* has been reported by Calder and Fosse (Porton) and in detail from the United States (1943). Much work of varied character has been in progress in Edgewood Arsenal, United States, upon *BAL* and other dithiols. For the last two years Spray[39] has worked upon metabolism of *BAL*. As an interesting application, Lovatt Evans found some prophylactic and therapeutic action of *BAL* in arsine poisoning in various species of animals and against the hæmolysis; independently, Levvy, of the Edinburgh team, showed that ethane dithiol protected mice against the lethal effect of arsine[40].

We may note at this stage that in addition to the practical applications, the discovery of *BAL* forms an important advance in theory. The theory that a biochemical lesion in a tissue formed by the partial blocking (as by the partial deficiency) of an enzyme system can cause pathological damage is strongly supported; the poison produces in effect an enzyme deficiency. The idea that the site of attack of trivalent arsenicals is upon essential —SH groups in this enzyme-protein is confirmed. That interference with the degradation of carbohydrate at the pyruvate stage is serious for tissue cells is supported by the damage produced by low concentrations of t arsenical to the pyruvate system, and by the accum lation of pyruvate in the blood produced in arsenic poisoning. It is surely also very significant th pathological change can be proved to be reversib

Chemistry of the Dithiols

Several 1 : 2 and 1 : 3 dithiols, prepared by t action of hydrosulphide on the corresponding halogen compounds, were condensed with dichl arsines, aldehydes and ketones giving rise to dit arsenoles, dithiarsenanes, dithiolanes and dithianes

Gasson, Millidge and Woodward[50] were responsi for the adaptation to technical manufacture and t introduction of stabilizers for the distillation proce In an attempt to avoid the use of bromine, Ing a Robinson[41] succeeded in raising the yield of dichl propanol from 40 per cent[42] to 64 per cent by the u of ether – HCl as a solvent for the chlorination. Sin however, the conversion to *BAL* requires a high temperature and pressure it was not convenient take advantage of this discovery on the large sca Work was initiated in Oxford early in 1941[32] in t attempt to get less toxic dithiols and some wi higher water solubility which would be more favou able for injection. This problem has also been pursu intensively in the United States. So far, with t exception of the discovery of *BAL Intrav* by anoth British group, which is separately reported, this wo has not brought to light such a compound. It interesting to note that 1 : 3 dimercapto 2 propan differing from *BAL* only in the position of the seco —SH group, is much more toxic. By the use of homologous series of dithiols Whittaker[43] was able show that there was a fall in the effectiveness dithiols with compounds which would be expected make a ring containing seven atoms, thereby su porting the ring hypothesis.

Medical Applications

These aspects are now being pursued in Brita under the ægis of the Medical Research Coun (*BAL* was initially described as *OX* 217 for securi reasons). Treatment of arsenical accidents in t factories with *BAL* ointment proved very successful It was early realized that there were possible app cations against both the toxic complications therapeutic arsenical drugs, and inunction therapy w used by this group in 1943. These aspects develop much more rapidly in the United States, where su cessful inunction treatment of arsenical (*D M*) d matitis was early obtained. This method was i mediately superseded by the preparation in t United States of an ampoule (using as a vehi 10 per cent benzoyl benzoate in arachis oil) whi was suitable for intramuscular injection of *BA* This has been extensively used, both in the Unit States and also under our direction in Britain. Ve favourable results were reported from the Unit States in the treatment of the complications arsenical therapy such as dermatitis and encephalit Of a series of thirty cases in England, some we treated by inunction early in 1943 and the later on with an ampoule following the U.S. formula, after t became available; it was believed that some 50 p cent cases had responded to the treatment favo ably[45]. This is much better than any other treatm so far tried, but a final judgment will have to based upon a larger series of cases. Based up American experience, initial dosing can now be high as 4 mgm./kilo *BAL* at four-hourly interva has been found both in Britain[46b] and the United ates that after recent dosing with 'Mapharside' the cretion of arsenic in the urine is definitely increased administration of *BAL*; after longer intervals m dosing with the arsenic compound, however, it more difficult to pick up any extra differences due the *BAL*, which are masked by the large daily riation in arsenic excretion usually present. This s well illustrated in the urines of the patients alysed by the Edinburgh group[45]. Enzyme experi- nts have shown that *BAL* will protect against the xic effects of therapeutic arsenicals[38]. The com- und of *BAL* and 'Mapharside' appears slightly more sociable than that with lewisite and requires the esence of excess of *BAL* for its stabilization and duction in toxicity to rats[47]. An important indica- n for treatment has been raised by Cameron, rgess and Trenwith[48]. Animals with renal damage oduced by injection of uranium acetate showed no fference in their response to large doses of *BAL*, hereas animals with livers damaged by carbon trachloride showed toxic signs. This suggests that patic damage is a contra-indication to the use of *AL*.

Finally, arising out of an investigation on colour actions, it was found that very stable and un- ssociable metal compounds were formed with thiols[32,39]. This observation initiated tests of thiols in other cases of metallic poisoning, an aspect the work which is now being actively explored th in Britain[49] and in the United States.

Acknowledgments

It is almost impossible in a short space to thank l those who have contributed in various ways to e success of this investigation. The work gained y regular discussions in the Department with the ustard gas group (J. St. L. Philpot, A. G. Ogston nd E. Holiday); much is owed to the co-operation f the permanent staff at Porton, among whom may e mentioned Surgeon Capt. Fairley, and also to Prof. . R. Cameron. Without the support of Mr. J. avidson Pratt and his colleagues at the Ministry of upply during these years and especially when the wer biochemical views were on their trial, nothing uld have been accomplished; we have also received lp and valuable criticisms from their various ientific advisory committees. Our thanks in this epartment are due to the Nuffield Committee, xford, for grants in part aid of this work. We are rateful to the Chief Scientific Officer, Ministry of upply, for permission to publish the facts.

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SCIENCE AND ETHICS

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THE development of methods and techniques for the release of atomic energy and the actual employment of the atomic bomb have demonstrated to the world at large, not only the immense and ever-expanding potentialities of science, but also the immediate power which lies in the hands of men of science. Hitherto the majority of those concerned with the fundamental sciences have not been directly concerned with the exercise of power but with the pursuit of knowledge. With the vast extent of their material power revealed, it now becomes both possible and imperative for them to discover the extent of their moral power and, taking their stand on ethical grounds, to indicate the full part which they are willing and able to play in human affairs and also the conditions under which they will in future agree to the conscription or hire of their minds. In order that they may do this, two things would seem necessary. First, recognizing that their work and its needs ensure for them certain privileges and that these very privileges have hitherto compelled a certain detachment from human affairs, they must more generally accept that they have other important functions as leaders in world citizenship, functions which are to-day increased in their importance by virtue of their new achievements. Secondly, they must surely, in their local, their national and their international assemblies and in the course of their teaching, consider and affirm at the earliest possible date, and frequently thereafter, what they consider to be their particular duties and their rights.

The man of science has always been influenced by certain ethical ideals connected with the conduct of his science and his association with his fellows. Intellectual integrity and freedom, the absolute necessity for veracity, and precision, the sharing of new knowledge, the obligation to publish important findings, the recognition of priority where priority is due—all these, together with his perfections of method, have made his discipline a thing apart, and the disciplines of some other professions seem poor by contrast. But he has not yet evolved a clear or comparable ethical code in respect of the relations of his science and his discoveries to the community and to the race.

We have an important precedent for the formulation and common observance of a more general ethical code by one profession. Medicine, a parent of the sciences, from the days of Hippocrates (whose famous *Oath*, together with the *Precepts*, *Decorum*, *Physician* and *Law*, defined the duties of the physician) has been constantly directed by a very binding and widely effective ethic relating not only to the conduct of its science and of its scientists and practitioners to one another, but also to the particular duties which medical men owe to man. Now it is obvious that the uses of medicine have been primarily and purposefully humane. Even so, the physician in all ages and in association with his particular powers has had plentiful opportunities for dubious or harmful actions of many kinds and for withholding or bartering useful knowledge for personal ends. It was these opportunities that made his ethical code necessary.

To-day we realize that all the other sciences are literally the physicians of man's future, that they could in time prevent or cure a thousands ills, but that they too have plentiful opportunities for harm. Is it too much to ask of the scientific fraternity in all countries that they should unite now in recognition of the absolute necessity for a declared ethical code and that they should proceed to its formulation? A provisional charter of rights and duties, outlined and circulated, let us say, by the Council of the Royal Society in Great Britain, and modified and agreed by the academies of science of other nations, discussed in all the learned societies and with students, and finally made public, would not only be received as a historical event of unique importance, but also would go far to restore a declining faith in the intelligence and prospects of man. It might, furthermore, do much to arrest the present deterioration in international sympathies and help both to neutralize the hostile suspicions of statesmen and to retard the schemes of the now dependent general staffs. For the declaration of such an ethical policy (however difficult it might be to implement at first) could mark the beginning of a rule of reason and would, in essence, constitute a powerful plea for non-co-operation with industries and governments in all war-like and ant social preparations and equally an insistence on the fuller co-operation in scientifically proved measur for human betterment. The engineer, the technicia and the public have, perhaps, a right to look f leadership to the accepted leaders of thought i matters of such moment. Morality and social servi concern us all, and, whenever possible, should b related to our more special tasks.

Let us return, for illustration, to the ethics of th physician. Medical men are ordinary men wit ordinary human frailties. We know that there a occasional back-sliders among them and that, whe their fault is grave, they become subject to stron disciplinary action at the hands of the profession own tribunals. But we know also that, by and larg medical men have maintained high standards throug the centuries and that their individual and corporat morality ensures for them the trust and respect the community. They do not engage in profit fro the sale of medicines; they seek no material rewar from their discoveries; they care for the sick an wounded enemy in war-time; they have the good the individual, the community and the race in min whatever their branch of the profession may b Accepting, as they do, the principle which was condensed in the Hippocratic injunction "to help, or a least to do no harm", it is difficult to believe that an responsible group of physicians or pathologists coul be found in any country to subscribe to bacteri warfare, even if they were able to discover an effectiv method without repercussions, and even if th strongest pressure were brought to bear upon the by a government and its military leaders.

Ethically speaking, is there anything to choos between an organized cholera epidemic and an atom bomb? With the Second World War behind us an a general agreement that a Third World War, employing atomic weapons, would be the end of ou civilization, what case—whether ethical or practic —can the physicists put forward for any new co-operation directed specifically towards the development of these weapons? International agreemen and controls may accomplish much; but they a not enough. The fullest possible opportunity an expression must also be given to moral decisions, an these should be based on finite knowledge as well a ideal thinking.

What has been said has reference to the prese and the future. It implies no criticism of the remarkable contributions of our men of science to the victorious prosecution of the War. It may be assume that the military decision to drop the two bombs o two densely populated cities, instead of on an unpopulated 'demonstration' area of Japanese territory, wa not the choice of the men of science and may well ha been opposed by them. But now that they know th potency of the new material agencies and how the discoveries may be utilized, can they do otherwi than decline to be further associated with militari preparations? Anxious as they must be "to help, o at least to do no harm", should not their futu direction of applied atomic research be exclusivel towards the development of its beneficent and productive uses? And, is there any body of men mo likely than they are to reach international agreeme on a decision of this nature?

Ethical ideals and policy should not, however, b considered only in relation to possible future war The scientific worker's mind may be conscripte through economic necessity or otherwise hired, n

ly for secret *ad hoc* undertakings under government,
ut also for the ends of private profit and sometimes
r purposes which he cannot, in his heart, approve.
his liberty and his right to communicate or publish
e restricted by an employer, he must deny a part
his already accepted ethical code. If he is party
the production of over-costly materials which
ould benefit the whole community, he must deny
e humanist morality now required of him.

So powerful, however, is the position of men of
ience to-day and so considerably has their prog-
ostic ability increased, that they could become, in
me measure, the conscience as well as the technical
lvisors of the State. In the face of a concerted
eclaration of rights, the exploitation of those younger
en of science who cannot find a place in academic
ork and whose skills could, under just conditions,
usefully employed, would be made at once more
fficult and eventually impossible.

In a more positive sense, right actions in a social
gard could be more frequently sponsored by the
uthoritative pronouncements of important scientific
oups. Social responsibility should to-day extend to
e effective instruction of the community and of
ntral, local or colonial governments whenever
olicies touching the public weal are in question and
pecially when full scientific support for a particular
eneficent policy is forthcoming. Here, for example,
edical science could already make a larger con-
ibution. Nutritional physiology had for some time
tablished the basic human requirements, and yet it
ok a world war to ensure for the working people of
reat Britain an equitable distribution of necessary
ods. We still accept in England an annual death-
ll of between one and two thousand children from
ovine tuberculosis and much other sickness and
isability due to contaminated milk. The occasional
rotests and individual writings of physicians and
ygienists have been educationally insufficient to
ounter ill-informed opinion and to secure necessary
gislation for the universal pasteurization of milk for
uman use.

The full responsibilities of the science teacher to
is students also call for thoughtful revision. The
te Prof. J. S. Haldane, in his Gifford Lectures (1928),
oncluded an argument concerning the fundamental
haracter of psychological or humanistic knowledge
ith the following sentence: "It follows that the
asis of a sound education must be humanistic, and
hat even the teaching of abstract sciences such as
athematics or physics should, through the history
f these sciences or in other ways, be connected with
uman interest".

Seventeen years later an alliance of science and
umanism in the teaching of our schools and univer-
ities has become more than ever necessary.

Ethical ideas and practice, phenomena peculiar to
uman societies, will in due course be themselves
ubjected to more intimate and scientific study, as
e have been lately reminded by Julian Huxley in
is Romanes Lecture (1943), by Waddington and
thers. But in the meantime we have evidence on
ertain major issues which compels us to assume right
f judgment. Moral thinking and teaching are not a
rerogative of the philosopher and the theologian.
or can they thrive in dissociation from other
pecific intellectual activities. Fundamental physical
tudies and humanistic studies can no longer proceed
fely in complete separation. The Good, as well
s the True, has become a necessary objective of all
ience.

OBITUARIES

Prof. N. I. Vavilov, For.Mem.R.S.

NEWS has recently been received of the death in the Soviet Union of Nikolai Ivanovich Vavilov. The circumstances are not precisely known, but the time was after December 1941 and the place probably Saratov.

Vavilov was born in 1885 and was the son of a textile manufacturer. His sister was a medical woman and died of typhus during the First World War. His brother is a physicist and is now president of the U.S.S.R. Academy of Sciences. He had two sons.

In 1913 and 1914 Vavilov worked with Bateson at the newly established John Innes Horticultural Institution. There he published a paper revealing one of the main lines his thought was to follow: "Immunity to Fungous Diseases as a Physiological Test in Genetics and Systematics exemplified in Cereals" (*J. Genet*, **4**, 49–65). His idea was Darwinian, but its development was genetic in the modern sense. Its novelty depended on his taking the practical problem of host and disease as seen by the pathologist, and turning it upside down.

Vavilov returned to Moscow in August 1914, not without mishap. His valuable experimental materials were lost with the S.S. *Runo*, which struck a mine on the voyage home. During the War, he began the second of the important lines of his life's work—namely, exploration for cultivated plants. He visited Persia and the surrounding countries in 1916, principally in search of the cereals, the systematic relationships of which he had already examined experimentally.

In 1917 he went as professor of agriculture, botany and genetics to Saratov. Here he wrote the paper which provides the third line in the origin of the new methods combining systematics and genetics which he was to adopt, "The Law of Homologous Series in Variation" (*J. Genet.*, **12**, 47–89). Finally, in 1921, he was picked by Lenin for a post of unexampled opportunity. He found himself, at the age of thirty-six, president of the Lenin Academy of Agricultural Sciences and director of the Institute of Applied Botany.

Inspired by his own enthusiasm, and by Lenin's determined policy, Vavilov set up more than four hundred research institutes and experimental stations in the course of a few years. Several of these had as many as two hundred research workers, and the total number of their staffs in 1934 amounted to 20,000. His journal, the *Bulletin of Applied Botany, Genetics and Plant Breeding*, with its comprehensive surveys and its numerous supplements, became a leading international organ of publication in its field.

In these days it was a remarkable sight to see Vavilov at work in what he now called the Institute of Plant Industry, the palace which he had converted to his use. Here he would be, in his shirt sleeves, sprawled over a map of the Soviet Union covering the floor of his office, busy distributing and arranging his staff and stations. No less remarkable was the experience of flying with him from one to another and watching his vigorous, confident and cheerful handling of the machinery he had created and of the people who were working it. Wherever he went he took sunshine and courage. Nicolas III (as he playfully called himself in contrast to the statue across the road) certainly got things done.

In spite of these vast administrative duties, Vavilov found time to direct the precise scientific methods to be followed in his institutes, especially in regard to economic botany and the question of immunity to disease in plants. He set to work to make thorough collections of varieties of economic plants over the whole of their ecological range. These were to be the raw materials for synthesizing new types for specialized regions. During the years 1923–31 he organized and carried out, often alone, a series of expeditions to what he regarded as the important economic plant regions of the world—to Afghanistan, Abyssinia, China, Central and South America—to collect material of all economic plants of interest to the Soviet Union. As an example of the scale on which the work was planned, no less than 26,000 varieties of wheat alone were obtained and kept in cultivation at Leningrad. At the same time he made the Soviet Union itself the chief ground for similar studies of the origin and distribution of varieties of livestock, horses, cattle, reindeer, and so on.

These collections were also to be the raw materials of new theories, theories on the origins of cultivated plants which he set out at the Fifth International Genetics Congress at Berlin in 1927, and later embodied in his "Theoretical Bases of Plant Breeding" (1935, Russian text). His crucial idea was derived from plant systematics. It was that the geographical centre from which a species of cultivated plant spread was marked by the greatest genetic diversity and also the greatest concentration of dominant genes. The meaning and validity of this contention have been disputed on both special and general grounds. Its value, however, was, and remains, in its effect in making possible the combined and rigorous systematic and genetic (including, of course, cytological) treatment of variation within species of cultivated plants. In theory, Vavilov marked the first great advance on De Candolle; and in practice he laid the foundations of all future improvement of crop plants. His own potato collection, for example, led to the establishment of the British Empire Potato Collection on which potato breeding is now being based in Britain and elsewhere.

Vavilov himself led the expeditions to Abyssinia and South America. The Abyssinian expedition was his first. It was economical; Lenin allocated to it the small grant of £1,000. It was also arduous; for six weeks in the mountains Vavilov did not remove his overcoat. He ate native food, slept on the floor of native huts and most of the time he suffered from typhoid or dysentery.

His unsleeping mind, his untiring body, his ambitious plans, even his flamboyant showmanship, were all Napoleonic in character. But his intellectual integrity was never in doubt. Whenever he met another man of science for the first time he would ask, "What is your philosophy?" In other words, "How do you approach your problems?" Vavilov himself approached his problems in a spirit of perpetually youthful inquiry and optimism, never forgetting however, as he used to say, that "Life is short". His attitude is well illustrated by a quotation from his last publication (in "The New Systematics", Oxford, 1940). "We are now," he writes, "entering an epoch of differential ecological, physiological, and genetic classification. It is an immense work. The ocean of knowledge is practically untouched by biologists. It requires the joint labours of many different specialists—physiologists, cytologists, geneticists, systematists, and biochemists. It requires the international spirit, the co-operative work investigators throughout the whole world. . . . do not doubt that the new systematics will bring to a new and better understanding of evolution, t great increase in the possibilities of governing t processes of evolution, and to great improvement our cultivated plants and domestic breeds of anima It will bring us logically to the next step; integrati and synthesis."

Already, however, after the notorious genet controversy at the end of 1939, from which t Lysenko school emerged successful, Vavilov h apparently lost his executive positions, and, in sp of many attempts, his friends failed to communic with him. His work and his workers seemed to fa away; and, when Leningrad came to be besieg the residue of his collections was eaten by t famished people. But though, in later years, he w thought little of by the Soviet authorities his fa abroad steadily increased. He was asked to president of the International Congress of Genet in 1939—an honour which he had to renounce, aft first accepting, when the Russians decided to ta no-part in the Congress. In 1942 he was elected foreign member of the Royal Society.

Vavilov spent all his life collecting and observi and arranging facts and ideas, many of them outsi the field of science. In his travels he was helped being a good linguist. With the same enthusias with which he studied their agriculture, he follow the customs, the music and the arts of the peopl he journeyed among. Physically he was of stoc build and dark complexion, with a Tartar cast countenance. A host of friends in Europe a America will lament his death. They are not like to forget his Robesonian depth of voice, his Falstaffi breadth of gesture. But science at large will rememb his achievement, an achievement that survives h personal disaster.

S. C. Harland.
C. D. Darlington.

Dr. L. A. Borradaile

Lancelot Alexander Borradaile, who died hospital on October 20, aged seventy-three, w known to most medical and zoological students of t last twenty-five years. Wherever English is spoke he was the author of their first text-book, "Manu of Zoology", and a shortened form when medic examinations became more strenuous. He was t son of a city merchant in the African trade who family came from the Lake District. Educated Blackheath and Felsted, he entered Selwyn Colleg Cambridge, receiving a scholarship in 1893 when obtained a first class in the Natural Sciences Trip a feat repeated in Part II, 1894, in spite of poor heal which prevented his taking part in games; t caused a certain neglect in his schools and he beca shy, which in his social life greatly hindered him.

In 1895, Borradaile commenced to demonstrate the Zoological Laboratory, Cambridge, where worked under Bateson on the variation in Crustac In 1899 he accompanied me round the coasts Ceylon and to Minikoi; he had already studi Willey's Stomatopoda and discovered the mar development of the coco-nut crab. In the tropics settled down to work on the biology, physiology a anatomy of land Crustacea, now regarded as classical research. This was followed by his thoug the varieties and species in the decapod crustaceans which he refers to "varietal characters" and ariations within a homogeneous species or variety". er this he published a series of memoirs ending in form of their classification. He regarded the crabs a true group with a common phylogenetic origin ough the Dromiacea. The attempt to show that main divisions of the Brachyura were ecological vell as morphological groups, based on adaptations swimming, sand-burrowing, sponge-carrying, sking' and so forth was very interesting and minating. This was followed by a further con- eration of land forms and the relationships of tain prawns, particularly the Pontoniinæ from the *lark* Expedition. He summarized some of his ws in two important papers in the *Annals and gazine of Natural History*. In 1922 he was awarded degree of Sc.D.

n 1908 Borradaile was appointed University monstrator in animal morphology and in 1910 turer, retiring in 1937. It was his own choice to cialize in the advanced teaching on invertebrates: divided his groups into full courses extending ough four terms in two years, choosing Crustacea l general questions relating to them, starfish, tochordates, protozoans and odd forms. He was ays clear, concise, and there was little original rk which was not included. He was at his best in practical classes, into which he developed in himf and his pupils an enthusiasm often started by ne question.

Borradaile had been taking his share of extra-mural turing for twenty years, when he published "The imal and its Environment", 1923, a subject which chose for lecture courses especially in East Anglia d to the Forces during the War of 1914–18: it gave to many a delightful hobby wherever they might reside, but the book was spoilt to science students by the publishers' view that the best form of illustration was by the reproduction of text-book and other well-known figures.

Dr. Borradaile was in succession lecturer, dean and then tutor of Selwyn College, and he helped both in his College and in the University during the war period, 1939 onward. He was offered scientific preferment, but his College held the first place in his affections. He was a most conscientious tutor, following the careers of his students, domestic and otherwise, often helping financially those in need. He was a wise counsellor, though his shyness prevented close friendships. He was very proud of being a freeman of the City of London and on the Livery of the Drapers' Company. He liked travel and he had a deep appreciation of pictorial art. In termtime in his later years his hobby was gardening—his dahlias 15 ft. high, fed from a compost heap, were known to all passers-by. In him Cambridge loses a notable figure ever helpful in all its activities.

J. STANLEY GARDINER.

WE regret to announce the following deaths:

Dr. Frank M. Chapman, emeritus curator of ornithology in the American Museum of Natural History, aged eighty-one.

Dr. J. F. Tocher, formerly lecturer in statistics in the University of Aberdeen, and consulting chemist to the Highland and Agricultural Society of Scotland since 1912, on November 8, aged eighty-one.

Lady Woolley, who took part with her husband Sir Leonard Woolley in archæological work at Ur of the Chaldees and elsewhere, on November 8.

NEWS and VIEWS

ience and Ethics

WHILE not agreeing with all the statements made Prof. J. A. Ryle in his plea for a more ethical proach to matters scientific (beginning on p. 619), feel that a suggestion that men of science should t together and devise some form of charter to ide their future activities is timely. Charters for n of science have been put forward for their con- eration on previous occasions; but there is one dition which seems to us to be imperative. That the charter must receive the support of, and be noured by, men of science in all countries; this es not seem likely of achievement if we have with men of science who are working under any kind political regime where they are subject to political ntrol and even orders. Absolute scientific freedom *every* country is essential if any form of charter to have the desired effect. Readers of *Nature* will all a suggested "Ethical Declaration for the Times" men of science by Mr. L. L. Whyte published ring the disturbed times of 1938 (*Nature*, **141**, 827; 38). That declaration read as follows:

DECLARATION

I am the inheritor of the tradition of civilization which s proved more lasting than empires. Whenever I use language or the products of science I unconsciously pay mage to the countless men for whom no sacrifice was great in the struggle to develop the human mind and ablish the truth. Toleration and freedom are the heart of this tradition; for individual thought and love of truth are the basis not only of science, but also of justice and of civilization.

I declare my loyalty to this tradition, my belief in the freedom of the individual to develop his talents for the enrichment of the community, and my conviction that man's community is now the whole human race, within which each nation must play its characteristic part. The natural balance between personal freedom and the proper demands of society, which is the life and health of civilization, is to-day doubly threatened; in certain societies by the denial of freedom and in the democratic countries by the irresponsibility of individuals. In the face of this threat:

I pledge myself to use every opportunity for action to uphold the great tradition of civilization, to protect all those who may suffer for its sake, and to pass it on to the coming generations. I recognize no loyalty greater than that to the task of preserving truth, toleration, and justice in the coming world order.

College of Aeronautics: Appointment of Mr. E. F. Relf, C.B.E., F.R.S.

THE recent announcement that Mr. E. F. Relf, superintendent of the Aerodynamics Division of the National Physical Laboratory, has been appointed principal of the newly founded College of Aeronautics, will interest all those who are concerned with the well-being of British aeronautics. The purpose of the College, as defined in a recent report published by H.M. Stationery Office, is to provide a high-grade engineering, technical and scientific training in aeronautics for selected students to fit them for leadership in industry and civil aviation, in the Services and in education and research. The College has a governing body of its own, representative of all the interests concerned. Nevertheless, the principal and his staff must bear the responsibility for setting the standards and establishing tradition, especially in the early days. Mr. Relf served an apprenticeship for five years in Portsmouth Royal Dockyard. In 1909 he was awarded an open Royal Exhibition tenable at the Royal College of Science, where he won the Tyndall Prize for physics in 1910 and obtained the diploma of the College in 1912. He was appointed to the staff of the National Physical Laboratory in 1912, and thirteen years later was made superintendent of the Aerodynamics Department.

During his early years at the National Physical Laboratory, Mr. Relf was engaged on aerodynamic researches and, under Stanton, Bairstow and Southwell, made a noteworthy contribution to the establishment of the international reputation of the Department. One of his outstanding achievements at that time was the design of the balances and controls for the compressed-air wind tunnel, a very powerful research equipment which enables air-flow problems to be studied over a very wide range of Reynolds numbers. Owing to the high pressure in the tunnel (up to twenty-five atmospheres) direct operation of the balances is not possible: they must either be automatic or operated from outside the tunnel. After a great deal of thought, Mr. Relf decided to base the design on the principle of the Kelvin current balance and in such a manner that an observer could measure, at any moment, the forces acting on the model in the tunnel. The successful operation of the balances under the stringent conditions existing in the tunnel is a testimony to his skill and foresight. After his promotion to superintendent, administrative duties and committee work made an ever-increasing demand on his time, but he could always find time to give guidance and sound advice to members of his staff. Mr. Relf is a member of the Aeronautical Research Council and of several committees of the Ministry of Aircraft Production. He has always been keenly alive to the value of a close contact between research and industry, and he has taken every opportunity to get first-hand information on the problems of aircraft firms. The best wishes of his many friends will be with him in the tasks that await him at the College of Aeronautics.

Chair of Pharmacology, College of the Pharmaceutical Society

Dr. G. A. H. Buttle has been appointed to the chair of pharmacology at the College of the Pharmaceutical Society, in succession to Prof. J. H. Gaddum, who now holds the chair of pharmacology at the University of Edinburgh. Prof. Buttle returns from a long and varied experience in the Army, in which he held the rank of lieut.-colonel, R.A.M.C. He served for six years as officer commanding Base Transfusion Unit and adviser in resuscitation with the Middle East Forces and later with the 21st Army Group. Previous to the War, in conjunction with Henry, Trevan and Stephenson, he published work on chemotherapeutics from the laboratories of the Wellcome Foundation, including much work on the antibacterial action of sulphanilamide and allied substances in streptococcal infections. In conjunction with Colebrook and O'Meara he demonstrated the inhibitory effects that sulphanilamide compounds had on bacteria out the body. During the War, in conjunction v Lieut.-Colonel G. Mitchell, he published invest tions on the treatment of infected war wounds v powder of sulphanilamide and derivatives of acrid and several articles on blood transfusion for ser purposes. As director of the Pharmacological L oratories in the College of the Pharmaceut Society, he will be able to continue the work of B and Gaddum on biological assays, and will undou edly be a great asset to the team of research worl already engaged on the chemical aspects of chemo therapy.

Agricultural Economics Research Institute, Oxfo Appointment of Prof. A. W. Ashby

Prof. A. W. Ashby, professor of agricultu economics at the University College of Wa Aberystwyth, who has recently been appoin director of the Agricultural Economics Resea Institute, Oxford, in succession to Dr. C. S. Orw was a scholar of Ruskin College, Oxford, and la was the first holder of a research scholarship at Institute to which he is shortly to become the he After a period of study at the University of Wiscons he was attached to the Food Production Departm of the Ministry of Agriculture during the First Wo War, returning afterwards to the Institute as sen assistant. Appointed to Aberystwyth in 1924, created the Department of Agricultural Econom there, and began a study of the economic proble of farming in Wales out of which has developed advisory service, particularly in connexion with t co-operative movement, which has proved of first-ra importance to Welsh farmers.

The chair of agricultural economics at Aberystwy to which Prof. Ashby was elected in 1929, was the fi in the subject to be created in Great Britain, and educational work has attracted students from ma parts of the world. As a member of several roy commissions and departmental committees, t National Council of Agriculture and the Agricultu Wages Board, his experience and knowledge ha been freely drawn upon by the Ministry of Agricultu and by agricultural organizations in England a Wales. Prof. Ashby is entering upon his new dut at a very critical time in the history of agricultu when the artificial prosperity induced by war co ditions will shortly pass, and the industry will ha to establish itself upon a peace-time footing. such conditions, few better fitted than he could found to direct research into the problems wh confront those whose interests and livelihood are the land, and to play a part in framing the educati which university students, both undergraduate a postgraduate, will need.

Adam Hilger Ltd.: Research and Developmen

Group Captain A. C. Menzies has been appoint controller of research and development to the firm Adam Hilger, Ltd., and commenced his duties November 14, succeeding Mr. F. Twyman in th capacity. Mr. Twyman continues with the firm managing director and technical adviser. Dr. Menz saw active service in the War of 1914-18 as a seaple pilot in the Royal Naval Air Service, and af graduating from Cambridge had appointments physics at the University of Leeds, Univers College, Leicester, and University College, Southam ton. At Leicester he inaugurated the Physics Depa ment in the newly formed College, and at Southam he held the chair. In December 1944 he was pointed to the chair of physics at University lege, Swansea, the appointment to take effect er demobilization; but by the courtesy of the lege was released from this and enabled to join am Hilger, Ltd., where his specialist knowledge administrative experience will be of particular ue. During the War he was in charge of operational earch at the Air Ministry and was deputy director science and deputy scientific adviser; and, since ember 1944, when Sir George Thomson retired m the post, he has been acting as scientific adviser, ding a peace-time appointment. He has specialized spectroscopy, first in atomic spectra, later in the man effect.

ence in the United Nations Organisation

MEMORANDUM by Mr. Guy B. Gresford, Australian ntific research liaison officer in London, entitled e Scientist and the Economic and Social Council", r referring to the major part played by the man science in the Second World War and to some of achievements which have been among its most king features, points out that, particularly among United Nations, scientific workers were called t the highest level in the prosecution of the War, help in formulating as well as in the execution of ns. Mr. Gresford's memorandum argues that it is as important that the man of science should y his part in the international organizations igned to ensure economic and social progress for nkind as a whole. His place in the functional anizations is obvious; but Mr. Gresford points out t it is equally necessary for him to be included hin the scope of the Economic and Social Council, ch, in securing expanding economic and social gress, must rely largely on scientific and technical owledge. In planning for the future, the Council st refer to scientific experts, not only to ascertain present state of knowledge as it affects a parlar project, but also to attempt to forecast the gress likely to be made in the future before effect be given to the plans. Mr. Gresford illustrates argument by reference to the interaction of rubber duction in tropical areas to the manufacture of thetic rubber, and the relation of long-term hydrotric schemes to the development of atomic energy. Accordingly, Mr. Gresford urges that the place of scientific worker on the Council should be that of ull working partner; only thus can the Council e the longest view and ensure that changes brought ut by scientific developments occur gradually and hout deleterious effects. Interchange between the nomist, the social worker and the man of science st be complete and at all levels. The Council will uire the best scientific advice that it is possible obtain, and should have at its call the leading ntific men of all fields. For this purpose, Mr. sford, like Dr. J. Needham (see *Nature*, 156, 401, ; 1945), suggests the establishment of a standing ntific commission to advise the Council on all ntific matters, as well as a small permanent ntific secretariat, and technical advisory comtees of distinguished men of science to deal with ticular projects outside the scope of the interional functional organizations. The standing mission would consist of twelve to fifteen members h an initial period of service of, say, three years, the secretariat would be composed chiefly of ly young scientific workers with an administrative t, seconded for a few years from national scientific organizations. If the Council established regional offices in connexion with the specialist organizations of the United Nations, Mr. Gresford suggests that the scientific side might establish an international liaison service, but on rather more modest lines than those proposed by Dr. Needham.

The Industrial Research Bill

THE Industrial Research Bill introduced recently into the House of Lords by Lord Barnby is intended to improve and strengthen the existing machinery for forming and operating industrial research associations in Great Britain. It is an 'Enabling Bill' under which the majority of interests in any industry can, if they so desire, put forward to the Board of Trade a scheme for operating a co-operative industrial research association. The Board of Trade will approve the scheme if adequate arrangements have not already been made to undertake the scientific research provided for by the scheme, if the scheme is in the national interest and if the promoters appear to represent at least half of the industry concerned, but the scheme will only operate if after such approval at least 75 per cent of the firms in the industry vote in favour. Special minority interests will be permitted to obtain exemption if they have already made their own adequate arrangements for scientific research, if they are too specialized to derive any benefit from a research association or if payment of contributions would involve serious financial hardship. The levy is not to exceed one per cent of the turnover or revenue of any firm. While the Bill does not deal with the scale of Government financial contributions towards the funds of the research associations, it is assumed that State aid would be forthcoming on a generous scale, in view both of the present arrangements and categorical assurances as to the intention of the Government to give the maximum support to scientific research and technical development.

Relics of Peking Man

ACCORDING to a New York correspondent of *The Times*, American agents have recovered from the Imperial University, Tokyo, crude tools, a carved tooth, jewellery and other objects looted by Japanese men of science from the cave at Choukoutien, in China, of the Peking man (*Sinanthropus pekinensis*). They will be returned to the National Geological Survey of China. Letters seized with the relics disclosed that the Japanese were never able to discover in a three-year search where the Chinese had hidden the skeleton remains of *Sinanthropus pekinensis*.

Rh and Blood Transfusion

THE future of the blood-transfusion services has been the subject of much anxious thought among those who have helped to create and man them and also among the general public. One important aspect of their future is discussed in a leading article in the *Lancet* (112, July 28, 1945). This is the possibility that *Rh*-positive blood may be transfused into an *Rh*-negative individual. The first transfusion of the *Rh*-positive blood causes the development of anti-*Rh* agglutinins in the serum, so that a subsequent transfusion of *Rh*-positive blood may produce an incompatibility reaction exactly similar to that which occurs when Group *A* blood is transfused into a Group *B* person, namely, hæmolysis of the incompatible blood cells and possibly jaundice or hæmoglobinuria. This reaction may be mild, severe or even fatal. Further, an *Rh*-negative woman may have been sensitized by having an *Rh*-positive baby, or by a transfusion of *Rh*-positive blood; if she then has an *Rh*-positive child, there is increased risk of erythroblastosis or of an allied condition in this child. Also, if an *Rh*-negative mother has an *Rh*-positive child and is sensitized by this child, her first transfusion of *Rh*-positive blood may cause an incompatibility reaction. American work has shown that this *Rh*-sensitivity may last for eight to twenty-two years. In addition to this, anti-*Rh* agglutinins cannot yet be always detected in the blood. R. R. A. Coombs, R. E. Mourant and R. R. Race have, however (*Lancet*, 15, July 7, 1945), described a new method of detecting weak and 'incomplete' *Rh* agglutinins in the blood (cf. also Coombs, R. R. A., and Race, R. R., *Nature*, **156**, 233 (1945) and the discussions by A. J. McCall and S. Holdsworth in *Nature*, **155**, 788 (1945) of hæmolytic disease of the newborn due to the antibody *St*, H. S. Baar (*ibid.*, 789). on the Race–Wiener test in hæmolytic disease of the new-born, and G. Plaut, M. Barrow and J. M. Abbott (*Brit. Med. J.*, 273, Sept. 1, 1945)).

The further difficulties of this problem and the measures to be taken to avoid the risks concerned are discussed in the *Lancet* (*loc. cit.*). Obviously they are matters for the expert, and everyone will support the conclusion that blood-grouping, especially when it is related to maternity work, can no longer be left in the hands of an individual pathologist, who may be employed upon this work only for part of his time; nor can supplies of *Rh*-negative blood be left to small panels of local donors. The post-war blood-transfusion service will have to be very carefully organized, not only to meet the known risks involved, but also to provide research facilities and personnel on a scale adequate to the future public importance of the whole problem. Blood-transfusion sources available during the War have provided one of the outstanding examples of the beneficence of scientific discovery. It would indeed be an indictment of our civilization if, now that peace has returned, we failed to give this particular service every encouragement and facility possible.

Religious Instruction in Schools

A Committee of Representatives of the Joint Conference of Anglicans and Free Churchmen, the Association of Education Committees and the National Union of Teachers has prepared a pamphlet entitled "A National Basic Outline of Religious Instruction" (London: National Union of Teachers, 1945. *2d.*). The pamphlet calls to mind an article bearing the above heading which appeared in *Nature* of November 14, 1942. Much has happened since then, but the article still stands as an explanation of the reasons why a scientific journal should in its own way deal with the problem of religious education. In particular, we retain the conviction that, after all is said and done, the psychological core of the problem lies in the relation of the teacher and the pupil, and that unless one can trust the teachers no precautions will avail. Choose the teachers carefully, train them adequately, and then trust them. The liberty of the well-prepared teacher is the essential condition.

The pamphlet is not a syllabus, but a broad 'outline' of the kinds of material that may by common consent be used in the making of a syllabus. The outline is quite unique in being national, not local (a national syllabus is an absurd idea, but a national outline is another matter). It is unique also in having been prepared by a committee in which teach were on equal terms with religious bodies and edu tion authorities. The outline repeatedly states t the true interests of the children have ever b paramount in its production. It might be ad in the same breath that the liberty of the teache the only way to secure the true interests of the ch ren. The idea of the broad outline, which ma no pretence whatever to be a syllabus, suitable any school, any teacher, and any social environm has enabled the committee to make suggesti especially for the older pupils, in directions that wil welcomed in many quarters, such as comparison Christian beliefs with those of other religions, Bible and science, miracles, and problems of pers and social ethics. "The spirit of enquiry," says Committee, "should be welcomed, stimulated fostered." That one sentence sums up the reas for giving strong approval to this basic outline.

British Bryological Society

On September 12 the British Bryological Soc held its first meeting since June 1939. It announced that, during the War, the Society eighteen members, including H. N. Dixon, P. Allo W. E. Nicholson, H. H. Knight, C. H. Binstead H. G. Jameson; new members during the same pe total nearly forty. It has not been possible to re contact with more than a few of the Continental m bers. It was decided to have a distribution of sp mens during the coming winter, and the time of next meeting was fixed for about Easter 1946, wit second one to be held during the winter follow Suggestions concerning biological observations bryophytes which might be usefully undertaken members were put forward and considered. advisability of publishing new editions of the Cen Catalogues of British Mosses and Hepatics was to the decision of a special committee. On Sept ber 13, Dr. S. Wyard led a party of twenty-ei members on a ramble in the neighbourhood Newlands Corner in Surrey. Although not a district bryologically, it yielded a few interest plants, including the rare *Dicranum strictum* Schlei a recent addition to the flora of Britain. In evening the party gathered at the South Lon Botanical Institute to hear Dr. P. W. M. Rich give a talk on "The Growing and Cultivation Bryophytes". Those interested in mosses or li worts can obtain particulars of the objects of Society and conditions of membership from secretary, Mr. A. Thompson, 23 Regent Cresc Skipton, Yorkshire.

Announcements

Dr. Herman Shaw, keeper in the Science Muse has been appointed director and secretary of Museum in succession to Colonel E. E. B. Mackint who will retire on November 30.

Dr. J. S. H. Davies, formerly of Imperial Chem Industries, Ltd., has taken up his duties as dire of research of the British Schering Research Insti in succession to Prof. D. H. Hey, who was rece appointed to the chair of chemistry, King's Coll University of London.

Erratum.—In the communication by Prof. S Kravkov and L. P. Galotchkina entitled "Electrot in Colour Vision" published in *Nature* of May 1945 (p. 605), the current used was 0·02 mA., not 0·2 mA. as stated in the penultimate line of first column.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Need for Development of Tropical Ecological Studies

THE development of the Colonies in respect of their plant resources should be at the present a matter of considerable importance, and anything which may hinder that development equally a matter of concern. As a result of numerous discussions between ourselves, and in the light of our varied experiences and contacts, we believe that a widening and broadening of tropical ecology is essential, especially in so far as it affects the workers in the field and the teachers in British universities. We have all come to the conclusion that our previous ideas or knowledge of tropical ecology gained from British universities were faulty in one or more important particulars. These misconceptions can be ascribed in part to a lack of balance in the academic teaching.

To quote an example: it is not sufficiently appreciated that tropical rain forest does not cover the greater part of the area of the tropics, and insufficient attention is given to the wide distribution of fresh-water swamp forest, desert and deciduous or semi-deciduous forests. Again, the part played by man—the devastating effects of shifting cultivation, grazing and burning, resulting in large areas of savannah and grassland, which in most areas must be regarded as biotic climaxes—does not receive the consideration that it merits. These observations are commonplace to workers with practical experience of the tropical areas, but their neglect affords evidence of a faulty emphasis in academic teaching which requires further consideration.

It is also fair to say that in many of the Colonies insufficient importance is attached to the study of ecology and its practical application to forestry. A proper understanding of ecological methods is imperative for the development of tropical forestry; this is clearly evident from mistakes that have been made in the past, especially in the adoption of extensive and costly planting schemes. A sound ecological knowledge is an essential prerequisite of any scheme for the improvement of wild forests by methods involving natural regeneration.

The faulty emphasis in academic teaching is no doubt due to the fact that ecologists from Europe have very often confined their attention to a study of rain forests, and as a result the published accounts represent an atypical sample of the natural vegetation. Another factor is the somewhat restricted circulation of papers written by forestry officers, because the main emphasis is laid upon timber and crop production. An ecologist has only to glance at the working plans and maps of a forest-working circle in order to realize at once the wealth of valuable ecological information that they contain, and which, if they had a wider circulation, would materially alter our ideas of tropical ecology. Forest and botanist officers are usually so occupied with routine matters that they have not the time to publish the conclusions and theories that result from their long experience and from departmental information.

An impasse has more or less arisen which will have to be broken. Newcomers to forestry departments are loath to write papers because so much of the ground work has been done for them and is available departmentally, and anything they write can only contain a modicum of new research. It is therefore imperative that heads of forest departments in the Colonies should specifically direct one or more officers to study the available information and write up descriptions of the various types of vegetation and any ecological conclusions that emerge*. Only in this way can the balance in academic teaching be readjusted. In this connexion a very strong case exists for the appointment, at a suitable rate of pay, of trained specialists, for example, ecologist, pathologist, to each forest department. The training of future recruits depends on publications, and forest officers have to decide whether they will not be contributing more to the general good by publishing such results as they have, or by leaving their results in the department because they feel that professionally they are not quite complete. It is appreciated that in the tropics the magnitude of the problems, the immensity of the areas and the infinity of the species make the worker cautious in publishing anything. This outlook is markedly absent among those of us who have been trained in areas of relatively puny communities with but few species.

There is also the fact that colonial journals of forestry and agriculture do not have a wide enough circulation at home. It is clear that for these various reasons a great deal of available information is not placed within the reach of those who need it. A great step forward in remedying this defect could be made by increasing the circulation of the journals and by directing officers to write up co-ordinated accounts of the vegetation in their districts. At the same time, teachers in Britain should realize that much information is available, and that if they are prepared to write to the departments in the various Colonies this information will be placed at their disposal.

A further means of redressing the present one-sided outlook would be for forest departments to arrange an exchange system, so that their older and more experienced workers returned to teach for a year at the universities while the academic worker came out to the Colony and studied with the field workers. A sound case can also be made for the appointment of specialist officers to groups of closely situated Colonies. Not infrequently officers in different Colonies and countries are ignorant of work carried out in other places, and specialists would not only be of great value to the departments, but they would also be in a strategic position to write balanced and co-ordinated accounts which would be of inestimable value to future recruits.

A further point which must be noted is the fact that the British Isles form a difficult ground for training ecologists who are going out to the tropics. The area is small and extensively modified by man, and it is very poor in species. On account of this, synecology is very largely being replaced by autecology, or the study of the species. The forester in the tropics is engaged in studying and employing his knowledge of the reaction of certain preferred species against a background of the economics of the community, so that to him community studies are of paramount importance. New methods of teaching ecology must be introduced if persons trained in the United Kingdom are to make the best use of their knowledge when they go to tropical regions. Thus the description of tropical forests in terms of detailed floristics or quadrats is of very little value. There is very strong ground, therefore, to put forward a plea for greater emphasis in research and teaching on biological spectra, internal climate, root distribution, biota, water relations, soil types, etc., as characters determining the aspect and form of any community. Students should be trained to make ecological comparisons without the necessity of producing detailed systematic lists. When the ecologist or forester arrives in the tropics he will find that one or other department has a trained systematist who can prepare any list he desires. Only with teaching of this type may methods used in one area be applied with confidence to other areas that are specifically different, but with similar features determining the physiognomy of the vegetation. A further contribution could also be made by the establishment in the tropics of research stations, including a central tropical ecological bureau, for research and teaching in all aspects of tropical botany and zoology. The ecological bureau would best be sited in India where co-ordination of the work of other research stations could be carried out and articles published from time to time. This has been advocated before, and it is to be hoped that some move will be made in the near future. Such places have unrivalled opportunities for making use of the knowledge of local officers who could not be spared for a year in the British Isles.

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* Champion's "Forest Types in India and Burma" is an admirabl model of what is needed.

In conclusion, it is hoped that these thoughts will be of value at a time when many Colonies will be restarting their departments and when, for some years to come, a big inflow of recruits will be necessary due to vacancies caused by the War. The gist of this communication may be summarized as follows: the somewhat lop-sided treatment of tropical ecology in British universities needs adjustment and more emphasis should be laid on non-floristic aspects. Forest departments in the Colonies should be prepared to publish their results, and their journals should have a wider circulation. Specialists should be appointed to forest departments of colonies or groups of colonies, and there should be an exchange arrangement of field officers with university teachers. Lastly, it is imperative that some more tropical research stations be established in the Colonies.

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A. L. Griffith.
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J. L. Harley.
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Oxford.

R. Hobbins.
Burma Forest Service.

C. H. Holmes.
Forest Department,
Ceylon.

C. de Rosayro.
Forest Department,
Ceylon.

J. Wyatt-Smith.
Colonial Forest Service,
Malaya.

Sept. 22.

Mass Departure of Locust Swarms in Relation to Temperature

Flying swarms of locusts often cannot be effectively attacked from the air because of the danger to the aircraft. Attention is therefore focused on the circumstances in which a swarm will remain on the ground. In Kenya the desert locust, *Schistocerca gregaria* (Forsk.), roosts overnight in trees and shrubs and usually takes to flight at some time during the morning. The prediction of the time of take-off is important in deciding the number of sorties an aircraft can make before the locusts leave, and therefore the number of aircraft required and the distance from which they can usefully operate.

We have followed a nearly mature swarm (changing to yellow) from near Sotik (lat. 00° 40′ S., long. 35° 11′ E.) to the laying ground near Kaputir (lat. 02° 00′ N., long. 35° 27′ E.), and we were able to study its behaviour on the ground on ten out of seventeen days during April 25–May 11, 1945. Results from two pink (immature) swarms studied on March 23 and on April 4 are also included below. On each morning continuous observations were made of the various meteorological conditions and of the behaviour of the locusts. By means of a thermocouple inside a hypodermic needle, which was inserted right along the abdomen into the thorax, about seventy observations of body temperature were taken per hour.

It is well known that in the early morning locusts bask in the sun, turning the body so that the largest area is exposed normally to the sun's rays. This behaviour leads to the body temperature rising far above air temperature, and we have many records of body temperatures 10–17° C. warmer than the air. At any one moment, locusts from different microclimates often have widely different body temperatures (for example, 22·5° and 37·2° C.). The time at which the locusts stream away in concerted fashion is fairly sharply defined and can be observed within five minutes; before this, many locusts have been flying about for some time, but now great masses of them take off together.

There is little constancy about the body temperature at mass departure, but the air temperature (meteorological screen and also sling hygrometer) varied only between 19·0° and 23·0° C. The following table shows the air temperature at the time of mass departure, and the upper and lower limits of body temperature just before that time. The first two sets of figures refer to the two pink swarms.

Air	Body	Air	Body	Air	Body
23·0° C.	34·8–38·0° C.	19·5° C.	26·5–36·0° C.	21·0° C.	24·8–38·3° C.
20·9	31·0–38·0	20·0	22·0–28·4	21·0	27·5–34·5
20·5	25·7–28·0	20·2	22·1–34·6	19·0	26·0–31·5
19·7	21·0–32·5	22·2	22·5–37·2	20·2	22·4–27·0

It is thus not possible to select a narrow range of body temperatures at which mass departure occurs. Such a range would have to include 27·0° C. (the highest body temperature for the coolest swarm) and 34·8° C. (the lowest for the warmest swarm). Actually, it is improbable that the initiation of mass departure is due to the warmest animals in a cool swarm and the coolest in a hot one, so that the range of representative body temperatures at this time is probably greater than 8° C. By contrast, the air temperature varied only by 4° C.

Locusts will not fly if the body temperature is too low. It appears that mass departure is not due, however, to a *metabolic* effect of the body temperature, once that is high enough, but is a *reaction* to air temperature. It is well known that it is inaccurate to speak of *the* body temperature of a locust, for the abdomen is often much cooler and nearer air temperature than the thorax. Presumably, the antennæ and legs will have a temperature approximating fairly closely to that of the air, so there is no sensory difficulty in postulating such a reaction. Air temperature, too, is not uniform when the locusts leave; there is often a gradient from the hot ground to the cooler upper air.

The important point is that mass departure appears to be correlated with air temperature, so that other factors affecting it can be studied with a sling or Assmann hygrometer, and the expensive apparatus and skill required for taking body temperatures are not necessary. Further data could therefore be accumulated fairly quickly and easily by workers on different species under widely varying conditions.

Some further observations made in Kenya this season on an immature swarm in conditions of higher air humidity confirm the general conclusion reached above, but put the air temperature of mass departure at between 17° and 19° C. There is also evidence that the settling of a swarm in the evening is correlated quite closely with air temperature.

This work is part of a programme of research under the Anti-Locust Research Centre and is sponsored by the Inter-Departmental Committee for Locust Control.

D. L. Gunn.
F. C. Perry.
W. G. Seymour.
T. M. Telford.
E. N. Wright.
D. Yeo.

Anti-Locust Flight,
Eastleigh,
East Africa.
Sept. 27.

Detection of Birds by Radar

In view of Lack and Varley's recent letter on this subject[1], it may be of interest to quote some passages from a German document prepared this year. Under the heading "Spurious Echoes" (*Scheinziele*), it is stated that "under special weather conditions up to 120 spurious echoes may be observed in an hour. Spurious targets occur especially near the mouths of rivers. Water temperatures which are higher than the temperature of the air seem to favour their appearance. There seems to be a definite connexion between wind direction and the direction of movement of the spurious echoes. Velocities up to 600 km./hr. The ratio of amplitudes between horizontal and vertical polarization is 3 : 1."

Apart from the figure for the velocity, all the facts given suggest that the spurious echoes are due to birds. I suggest that 600 km./hr. is either a misprint for 60, or else has arisen because one or two aircraft echoes have erroneously been reported among the *Scheinziele*. If the Germans really had observed false echoes travelling at such high speeds, we should surely have found them on our own very similar sets as well.

That birds are the cause of spurious echoes does not seem to have occurred to the Germans, for the document goes on: "The physical origin of spurious echoes is so far unexplained. It is probably a matter of sharply bounded layers of discontinuity in the atmosphere. Charges, cloud movements, aerial vortices, as well as the boundary region between two layers of air can be suggested as possibilities." It is then stated that such discontinuities have not been located hitherto, but that this may be due to the crudeness of the methods employed for the exploration of the atmosphere. A programme of research was, therefore, to be initiated on Heligoland, with the object of finding discontinuities only half a metre thick!

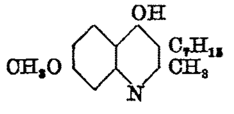
H. A. C. McKay.

Miscellaneous Weapon Development Dept.,
Admiralty.
Oct. 29.

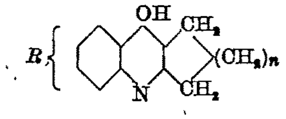
[1] *Nature*, 156, 446 (1945).

Antimalarial Activity in Tetrahydroacridones and Related Substances

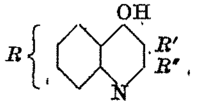
Fitch[1] has revealed the discovery by German workers of prophylactic activity in 4-hydroxy-7-methoxy-3-*n*-heptylquinaldine (I) against avian malaria. We have examined a number of tetrahydroacridones (II; $n = 2$), hydroxydihydro-β-quinindenes (II; $n = 1$) and 4-hydroxyquinolines for prophylactic activity in *P. gallinaceum* infections in chicks and have found noteworthy activity in certain compounds which, so far as the work has proceeded, conform to type (III), of which (I) and (II) are representative, R' and R'' being saturated hydrocarbon residues.



(I)



(II)



(III)

For example, 7-methoxyacridone shows no activity whereas its 1 : 2 : 3 : 4-tetrahydro derivative has a marked action.

The substances were prepared by the Conrad–Limpach reaction from the appropriate β-arylamino-αβ-unsaturated esters. A device which we have used for several years consists of effecting the cyclization in vigorously boiling diphenyl (b.p. 255°) instead of in liquid paraffin[2] heated to 260°; by this means the decomposition frequently accompanying this reaction is avoided and clean products are obtained in excellent yield.

A full account of this work will be published elsewhere at a later date.

Joan M. L. Stephen.
Isabel M. Tonkin.
James Walker.

National Institute for Medical Research,
Hampstead, London, N.W.3.
Oct. 22.

[1] Fitch, W. K., *Pharm. J.*, 182 (Oct. 20, 1945).

[2] Limpach, L., *Ber. dtsch. chem. Ges.*, 64, [B], 969 (1931).

A New Antimalarial Drug

Through the courtesy of Dr. J. Needham of the British Scientific Office in Chungking, samples of two indigenous plants regarded locally as of value in the treatment of malaria have been obtained and tested in experimental animals.

One of these, *Fraxinus malacophylla*, was found to be without action on *Plasmodium gallinaceum* in chicks. Contrary to the report of Liu *et al.*[1], no alkaloid could be found in the bark.

The root of a second plant, known locally as 'chang shan' and reputed to be *Dichroa febrifuga*, Lour., was ground and extracted with water and with dilute acid. Neither extract at a concentration where 1 c.c. corresponded to 1 gm. dry root gave the usual alkaloidal reactions, but both showed considerable activity against a trophozoite-induced infection of *P. gallinaceum* in chicks. The growth of exo-erythrocitic forms was not prevented by the extract.

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T. S. Work.

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[1] Liu, Chang, Ch'uan and Tan, *Chinese Med. J.*, 59, 573 (1941).

Effect of some Arylcarbamic Esters and Related Compounds upon Cereals and other Plant Species

In the studies of the control of plant-growth by chemical compounds at Jealott's Hill Research Station, attention has been given to those compounds which affect cell extension growth (plant-growth substances), and to those which interfere with cell division. An earlier communication[1] has described work on plant-growth substances as selective weed-killers. The present letter describes our work on compounds which affect cell division.

Colchicine, acenaphthene, chloral hydrate and ethyl phenyl carbamate, all well known for their effects on cell division, were tested upon cereals. Lefevre[2] has described the morphological and cytological changes in plants caused by ethyl phenyl carbamate. We found that ethyl phenyl carbamate arrested the growth of cereals at lower concentrations than did colchicine, acenaphthene and chloral hydrate.

In December 1940 a differential effect was discovered. Ethyl phenyl carbamate, applied at 50 mgm. per sq. ft. to oats sown with charlock, affected the oats but not the charlock. The oats germinated and the first leaf appeared through the soil; then, however, growth was arrested; the first leaf ceased to grow in length, but its base became very much thickened and bulbous and no further leaves appeared. Root-growth ceased, and after remaining in this static condition for some time the seedling withered and died. Under certain conditions, applications as low as 10 mgm. per sq. ft. gave this effect. We found that 10 p.p.m. ethyl phenyl carbamate in aqueous solution in contact with the germinating cereal seed brought about this morphological effect. Higher concentrations prevented germination.

The activity of about fifty related arylcarbamic esters and thiocarbamates was then examined. Judged by the concentrations required to give the morphological effect, the relative activity of some of these compounds was as follows :

n-Butyl phenylcarbamate	active, but much less than ethyl phenylcarbamate.
Ethyl *o*-methoxyphenylcarbamate	
Methyl phenyl thiocarbamate	
Ethyl phenyl thiocarbamate	
n-Propyl phenylcarbamate	active, but less than ethyl phenylcarbamate.
Ethyl *o*-chlorophenylcarbamate	
Methyl phenylcarbamate	
Allyl phenylcarbamate	
N : N-Di(carboethoxyaniline) ..	activity equal to ethyl phenyl carbamate.
iso-Propyl phenylcarbamate ..	Activity approximately three times that of ethyl phenyl carbamate.

Aniline, α- and β-naphthylamine, methyl carbamate, urethane (ethyl carbamate) and formanilide were inactive under the conditions of our tests.

Iso-propyl phenylcarbamate in concentrations which stopped cereal seedling growth did not affect the growth of mangolds, sugar beet, flax, rape and yellow charlock. In heavier applications it arrested the growth of established cereal plants even when these were in flower, and, once arrested, very little or no further growth occurred. In one interesting experiment, 30–50 mgm. per square foot applied to winter rye during mid-May when the ears were just appearing resulted in fully formed heads containing no grain. The ears remained upright, whereas those of the untreated plants bent over under the weight of the grain.

This action of the aryl carbamic esters on monocotyledonous plants and lack of action on dicotyledonous is especially interesting, since it is the exact converse of the action we discovered with the growth substances of the phenoxy acetic acid class of plant-growth substances.

Fuller details of these and subsequent experiments are being published elsewhere.

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W. A. Sexton.

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Dyestuffs Division, Research Laboratories,
Blackley, Manchester.
Imperial Chemical Industries, Ltd.

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[1] *Nature*, 155, 497 (1945).

[2] Lefevre, J., *C.R. Acad. Sci.*, 208, 301 (1939).

Crystallization and Identity of the Triose and Triosephosphate Dehydrogenases of Muscle

The triose (glyceraldehyde) dehydrogenase was studied by Green, Needham and Dewan[1], who concluded from its distribution that it was a different enzyme from the triosephosphate dehydrogenase. We have succeeded in isolating and crystallizing the triose enzyme from rabbit skeletal muscle. After this was accomplished, we discovered that the crystals were in fact those of triosephosphate dehydrogenase. Their activity is actually some three hundred times greater with triosephosphate than with triose. It is therefore no longer necessary to assume the existence of triose dehydrogenase as a separate enzyme, as the two are identical.

The triosephosphate enzyme from yeast was crystallized by Warburg and Christian[2], who found that the pure enzyme also acted on glyceraldehyde, though only at about a thousandth of the rate with triosephosphate.

Our procedure for crystallizing the muscle enzyme is as follows : 600 gm. of muscle from a freshly killed and bled rabbit is cooled in ice, minced and extracted with 1,200 ml. of cold glass-distilled water. The extract is squeezed through muslin and about

0 per cent of the enzyme adsorbed on 240 ml. of calcium phosphate gel (33 mgm./ml. dry weight), sually in two stages. The gel is then extracted three times with 60 ml. of $M/15$ phosphate buffer pH 7·4, and the inactive extracts discarded. The enzyme is eluted with 100 ml. of the same buffer containing 10 per cent of ammonium sulphate. To the eluate 30 ml. of 5 per cent sodium pyrophosphate is added, and after cooling to 0° the enzyme is precipitated with 1·5 vol. of cold acetone (− 10°). The precipitate is centrifuged down, dissolved in 80 ml. f water and any insoluble part centrifuged off. The solution is now brought to 0·55 saturation with 28 gm. of ammonium sulphate and the precipitate filtered off. The filtrate is brought to 0·8 saturation with 4 gm. of ammonium sulphate. The precipitate, which contains the enzyme, is filtered off, dissolved in 40 ml. of water and 12·4 gm. of ammonium ulphate added. Any precipitate is filtered off and o the clear filtrate N caustic soda is added cautiously with stirring to bring the pH to 7·5. Crystals appear after 1–2 hours. They can readily be recrystallized by collecting them on a filter paper, dissolving in 20 ml. of water, adding 6·7 gm. of ammonium sulphate and bringing the pH to 7·5 again. Our preparations have been recrystallized three times.

The crystals were found to be quite free from zymohexase and lactic dehydrogenase.

A point of considerable interest is the large amount of the enzyme present in muscle extracts. From the activity of the crystals we calculate that the triosephosphate dehydrogenase actually forms about 10 per cent of the protein in the muscle extract.

The presence of a small amount of inorganic phosphate is necessary for the oxidation of glyceraldehyde or phosphoglyceraldehyde by the enzyme. (The same is true of the yeast enzyme[2].) This is interesting in view of the fact that the latter oxidation is coupled with phosphorylation but the former is not[3,4]. The reason for this difference is being studied. The activity of the enzyme is increased by cysteine or reduced glutathione and also by pyrophosphate.

After this work was carried out, we learned from the note of Cori, Slein and Cori[5], which only reached Britain during the past few days, that they have independently crystallized the triosephosphate dehydrogenase from rabbit muscle. Our crystals are evidently identical with those obtained by them. They too direct attention to the large amount of the enzyme present in muscle extracts, and they have actually obtained 7 per cent of the soluble protein as the crystalline enzyme. They also observed the activating effect of cysteine.

The properties of the pure enzyme are very similar to those of the albumin known as 'myogen B', crystallized from rabbit muscle extracts by Bailey[6] and Baranowski[7] independently. We think it is probable that they are one and the same protein.

RANWEL CAPUTTO.
MALCOLM DIXON.

Biochemical Laboratory,
Cambridge.
Sept. 26.

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[1] Green, D. E., Needham, D. M., and Dewan, J. G., *Biochem. J*, 31, 2327 (1937).

[2] Warburg, O., and Christian, W., *Biochem. Z.*, **303**, 40 (1939).

[3] Needham, D. M., and Pillai, R. K., *Biochem. J.*, 31, 1837 (1937).

[4] Needham, D. M., and Lu, G. D., *Biochem. J.*, **32**, 2040 (1938).

[5] Cori, G. T., Slein, M. W., and Cori, C. F., *J. Biol. Chem.*, **159**, 565 (1945).

[6] Bailey, K., *Biol. Bull.*, **77**, 303 (1939); *Nature*, **145**, 934 (1940).

[7] Baranowski, T., *Z. physiol. Chem*, **260**, 43 (1939).

Molecular Morphology of Myosin

RECENT investigations of the Szent-Györgyi school[1] have led to much new information about myosin and its role in muscular contraction. One of the main results is that myosin can be extracted from muscle in two forms: myosin *s.str.* and actomyosin. From both proteins threads can be drawn; those of actomyosin show a considerable contraction upon addition of adenosinetriphosphate. In solution, both forms are distinguished by the much higher viscosity of actomyosin.

In order to estimate the dimensions of the particles of both kinds of myosin, I undertook a study of the viscosity and anisotropy of flow of solutions of these substances. The viscosity of myosin is, in not too high concentration, independent on the velocity gradient in the viscometer. Actomyosin is much more viscous and the viscosity is strongly dependent upon the shear.

The study of the flow birefringence likewise revealed striking differences between the two myosins. In the case of myosin *s.str.*, the angle of isocline approaches a value of 78°[2], while actomyosin shows complete orientation at very low velocity gradients. Moreover, in the latter case, the intensity of the anisotropy of flow is much higher. While the difference in viscosity suggests a much more anisometric shape for the actomyosin particles, the observations on the double refraction of flow show that they are much longer than the myosin particles. Finally, the study of the light scattering of the solutions showed that the diameter of both kinds of particles is probably the same.

The results were evaluated quantitatively with the aid of the hydrodynamic derivations of J. M. Burgers for the motion of anisometric particles in a streaming fluid[3], assuming that both myosin and actomyosin particles have a cylindrical shape. It was found that the myosin particles are 10,000–11,000 A. long and the ratio of length to diameter is 162; their diameter is therefore about 65 A. This is in agreement with the electron micrographic observations, which show threads of about 60 A. diameter[4], while the X-ray diagrams of myosin threads reveal a periodicity of 66 A. perpendicular to the fibre axis[5]. The particles of actomyosin have a length-diameter ratio of about 2,000 and a probable length of about 13 µ.

Addition of adenosine triphosphate to a solution of actomyosin lowers the viscosity and flow birefringence to the values found with myosin. While this could be explained as due to the contraction of the particles, consideration of the changes in light scattering suggest that it is due to disaggregation, and that actomyosin is an aggregated myosin in which the aggregation takes place solely in a longitudinal direction. Urea in a concentration of 5 per cent also causes disaggregation.

The quantitative study of the effect of adenosine triphosphate on several physical properties of myosin and actomyosin showed that myosin reacts with it in units of particle-weight 100,000. The same value is found for the molecular weight of myosin in 45 per cent urea[6]. These particles seem to be the units of the myosin molecule. Myosin and adenosine triphosphate form an undissociated compound in stoichiometrical relation. After being bound to the myosin, the adenosine triphosphate is split. This reaction is not inhibited by adenylic acid and phosphoric acid, as the splitting takes place only so far as adenosine diphosphate.

The investigation of the viscosity of myosin in 45 per cent urea showed that the units in question are single peptide chains with a length of 2,000 A. In the longitudinal direction of a myosin particle, five such chains are placed end to end, while in cross-section the particle has about 50 chains. It is striking that the total length of a particle (1 μ) is exactly identical with the length of the anisotropic disks of the muscle fibril.

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Hungarian Biological Research Institute,
Tihany, Lake Balaton.

(Prepared for publication, July 1943.)

[1] Szent-Györgyi, Studies from the Institute of Medical Chemistry, Szeged, 1–3 (Basle: Karger, 1942–43).

[2] v. Muralt and Edsall, *J. Biol. Chem.*, 89, 289 (1930).

[3] Burgers, "Second Report on Viscosity and Plasticity" (Amsterdam, 1938).

[4] v. Ardenne and Weber, *Koll. Z.*, 97, 322 (1941).

[5] Kratky and Weber, *Naturwiss.*, 31 (1943).

[6] Weber and Stover, *Biochem. Z.*, 259, 269 (1933).

Heat Coagulation of Muscle Proteins

A CHANGE in pH when proteins are denatured has been reported by other workers[1,2]. When making observations of the change in pH of meat resulting from heat coagulation, we were struck both by the magnitude and by the variability of the change. Muscle is a highly buffered system[3], and a change such as that observed, for example, from 5·6 to 5·9, indicates the production of a considerable amount of base.

The magnitude of a change in pH in a buffered system is of itself of little significance; what is important to know is the actual equivalent of base produced per unit weight of coagulated protein. We have therefore carried out experiments with muscle press-juice to determine this quantity, varying both the initial pH and the concentration of coagulable protein in the system.

The juice was obtained by grinding minced lean beef with washed quartz sand, and pressing through calico. Coagulable protein was determined by precipitation with trichloroacetic acid and determination of nitrogen in the precipitate. Results are expressed in terms of nitrogen. A series of dilutions of the juice was prepared. After measurement of initial pH with the glass electrode, the proteins were coagulated by immersion in boiling water, the coagulum cooled to 20° C., and the pH determined. The buffering power ($\delta B/\delta p\text{H}$) of the system in the range of pH covered by the observed change (ΔpH) was determined by titration, after coagulation, with 0·05 N hydrochloric acid. This enabled the increment in basic equivalents (ΔB) to be calculated.

The specimen data in Table 1 illustrate the effect of diluting the juice on the magnitude of ΔB. The first group relate to a sample of fresh meat, the second to frozen meat after several years in stor. In each case the initial pH was 5·5.

TABLE 1.

Coagulable N (%)	ΔpH	ΔB (milliequiv.) per gm. coagulable N.
1·05	0·22	0·94
0·525	0·21	0·76
0·263	0·18	$0{\cdot}57_5$
1·32	0·22	0·73
0·66	0·23	0·60
0·33	0·19	0·47
0·165	0·16	0·35

The value of expressing the results in terms of Δ rather than of ΔpH is evident when the figures i the last two columns are compared. Buffering pow changes considerably both with dilution and pH, is seen in Table 2. In the range studied, most of th variation of $\delta B/\delta p$H with pH is due to the phosphat present in the juice.

These experiments have been repeated with d alysed juice, in which the buffering is due to th protein alone, and values of ΔB of the same ord have been obtained, although ΔpH is, of cours much higher.

These results show that at any given pH, th production of basic groups is not, as one might hav expected, proportional to the amount of protei undergoing coagulation; ΔB per gm. of coagulabl nitrogen decreases with increasing dilution. If Δ per gm. of coagulable nitrogen is plotted agains the log of the coagulable nitrogen concentration, straight line is obtained. This effect is not due t incomplete coagulation, or to a shift in the curv relating ΔpH to pH, since it occurs at all pH value studied. Qualitatively, there seemed to be som correlation between the size of the aggregates forme and the concentration of protein, the larger aggregates being produced in the more concentrate systems, that is, those in which ΔB per gm. o coagulable nitrogen is greatest. This would sugges that the liberation of base might occur as a result o aggregation rather than of the denaturation whic precedes aggregation.

The effect of varying initial pH at constant concentration of protein is shown in Table 2. Th coagulable nitrogen in the press-juice in this instanc was 0·525 per cent.

TABLE 2.

Initial pH	Final pH	ΔpH	δB (milliequiv. per 100 c.c juice) / δpH	ΔB (milliequiv.) per gm. coagulable N
4·50	4·72	0·22	2·48	1·04
4·98	5·20	0·22	2·17	0·91
5·47	5·68	0·21	1·90	0·76
5·96	$6{\cdot}06_5$	$0{\cdot}10_5$	1·87	$0{\cdot}37_5$
6·02	6·13	0·11	1·97	0·41
6·46	6·46	0·00	2·82	0·00
6·70	6·65	−0·05	2·88	$-0{\cdot}22_5$
7·72	7·45	−0·18	1·64	−0·56

The change in sign of ΔpH and ΔB occurred, i this and other samples, at a point slightly on th acid side of neutrality. The predominating protei fraction in muscle juice is myogen, which has it isoelectric point at 6·5–6·7[4], and in following u the theoretical implications of these observations th fact deserves bearing in mind. It must also b remembered, however, that Pauli and Koelbl[5] foun this 'inversion point' to be in the neighbourhood o pH 8·4 in the case of egg albumin and serum albumin which is well on the alkaline side of the isoelectri point of these proteins.

The change in pH probably arises from at leas two distinct causes. Association of protein molecule into aggregates large enough to possess an effectiv internal phase at any pH other than the isoelectri point is likely to cause a change in the total charg on the protein component of the system, and therefore a change in pH of the aqueous medium in whic it is dispersed; and denaturation, whether accompanied by aggregation or not, in so far as it involve interaction between acidic and basic groups on th protein, must likewise affect the pH of the medium hese possibilities are being investigated by following e titration curves of the native and denatured pro-in and the changes in amino-nitrogen accompanying enaturation and coagulation.

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ow Temperature Research Station,
Cambridge. July 10.

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Activity of Helvolic Acid against *Mycobacterium tuberculosis*

THE earliest account of an action by *Aspergillus umigatus* on the tubercle bacillus appears to be hat of Vaudremer, who found that *Myco. tuberculosis* ncubated for 24 days in a filtered extract of *A. umigatus* lost to a large extent its acid-fast staining roperties and its virulence for animals, as compared with bacilli incubated in Raulin's culture fluid or in aline[1]. The active principle was thermostable[2]. He sed similar extracts to treat more than two hundred atients with tuberculosis, but clinical results were quivocal[3]. He also pursued the idea of using the ttenuated bacilli for the preparation of vaccines[4,5].

Zorzoli[6] found that medium on which *A. fumigatus* ad grown interfered with the growth of *Myco. uberculosis*; the active substance withstood 100° C. or one hour. Soltys[7] similarly found that medium rom this mould inhibited the growth of human, ovine and avian *Myco. tuberculosis* and *Myco. phlei*, nd that it had the same heat stability. By partial urification Asheshov and Strelitz[8] obtained an xtract from culture filtrates which killed B.C.G. at 1 in 500,000 and inhibited its growth at 1 in 1,400,000 nder the conditions of their experiments, though avian *Myco. tuberculosis* was not killed by a concentration ven as strong as 1 per cent. Kallós[9] and Gerber and ross[10] each reported that culture filtrate from an nidentified strain of *Aspergillus* contained a substance active against *Myco. tuberculosis*, and Miller nd Rekate[11] found an unidentified mould of which he mycelium inhibited its growth.

There is little information from the chemical evidence presented in these reports as to how far the activity of crude extracts against the tubercle bacillus might be accounted for by any of the antibiotic substances already isolated from the metabolic products of *A. fumigatus*. It may therefore be of interest to workers in this field to report the activity, under a given set of experimental conditions, of helvolic acid[12,13], the only one of these antibiotics which approaches the status of a chemotherapeutic agent. Mr. T. I. Williams, who had been working with helvolic acid, suggested making these observations.

Human *Myco. tuberculosis* in sputum was cultured by Muller's[14] adaptation of the slide culture technique[15], the medium being distilled water with 25 per cent packed human red blood cells from citrated blood, incorporating serial dilutions of helvolic acid (1 in 1,000, 10,000 and 100,000). The activity of the elvolic acid did not deteriorate during the incubation eriod of one week. When at this time the preparations were fixed and stained, some colonies, though fewer and smaller than in the controls, had developed in the presence of 1 in 100,000 helvolic acid, but the higher concentrations, 1 in 10,000 and 1 in 1,000, had suppressed multiplication completely.

Thus under these conditions of experiment, helvolic acid inhibits the growth of the tubercle bacillus partially at a dilution of 1 in 100,000 and completely at at least 1 in 10,000.

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University of Oxford. Aug. 16.

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A Polysaccharide from *Gigartina stellata*: the Isolation of Crystalline 2:6-Dimethyl-β-*d*-Galactopyranose from the Methylated Polysaccharide

THROUGH the kindness of Dr. A. P. Orr of the Marine Station, Millport, in supplying a quantity of *Gigartina stellata* which is used in the preparation of 'British Agar'[1], we have been able to investigate a polysaccharide isolated from this material.

After washing for a week in running water, the seaweed was extracted with hot water, the extract concentrated under diminished pressure and the hot extract precipitated with alcohol. The product is essentially a polysaccharide ethereal sulphate of $[\alpha]_D^{15°}$ + 51° in water, ash 17·5 per cent (as sulphate) giving Ca, 3·7; Mg, 1·0; SO_4, 12·7 per cent calculated on the weight of hot extract, whereas the total sulphate was 23·8 per cent.

Hydrolysis of the hot extract with $N/2$ oxalic acid followed by neutralization with barium carbonate gave *d*-galactose (40 per cent) together with the barium salt of an acid (30 per cent), the constitution of which has not yet been decided.

As with the polysaccharide ethereal sulphates of *Chondrus crispus*[2], which is also used in the preparation of 'British Agar', direct methylation of the hot extract was slow, but it could be acetylated readily in the cold after a preliminary treatment with pyridine[3]. Simultaneous deacetylation and methylation yielded a partly methylated product, the methoxyl content of which was raised by several similar treatments to *c.* 20 per cent. The methylated polysaccharide so obtained closely resembled the original hot extract $[\alpha]_D^{15°}$ + 43° in water, ash 18·2 per cent (as sulphate) giving Ca, 3·8; Mg, 0·9; SO_4, 12·8 per cent (calculated on the weight of the methylated hot extract); total sulphate 24·7 per cent.

Hydrolysis of this methylated polysaccharide and suitable treatment gave as the main product a dimethyl methylgalactoside (b.p. 145–155°/0·10 mm., $n_D^{10°}$ 1·4737) from which on methylation, hydrolysis and treatment with aniline a good yield of tetramethyl-*d*-galactopyranose anilide was obtained, thus indicating the absence of substitution on C_5. The dimethyl methylgalactoside ditoluene-*p*-sulphonate underwent no reaction with sodium iodide in acetone[4], indicating the presence of a methoxyl group on C_6. Removal of the glycosidic methoxyl gave a crystalline dimethyl galactose (m.p. 119–120°, $[\alpha]_D^{15°} + 48°$ (10 min.) $\rightarrow + 87{\cdot}1°$ (240 min. in water; constant)). This sugar on osazone formation gave pure 6-methyl galactosazone, proving substitution on C_2 and C_6. Further confirmation that this sugar is identical with the 2 : 6-dimethyl-β-*d*-galactose synthesized by Oldham and Bell[5] was obtained as follows. Oxidation gave a crystalline acid which, on distillation at 180°/0·02 mm., yielded a dimethyl galactonolactone $[\alpha]_D^{17°} - 49° \rightarrow - 24°$ (28 days in water, still incomplete), the negative rotation and slow hydrolysis proving it to be a γ-lactone. The dimethyl galactose on glycoside formation at room temperature gave a mixture of dimethyl galactofuranosides as shown by the negative rotation, $[\alpha]_D^{13°} - 43°$ in methanolic hydrogen chloride (1 per cent). These facts prove C_4 to be unsubstituted. The syrupy lactone gave an amide, m.p. 154–155°, $[\alpha]_D^{16°} + 46°$ in water, which gave a negative Weerman reaction, confirming the evidence from the osazone that a methoxyl residue is present on C_2.

The dimethyl galactose gave a crystalline anilide, m.p. 121–122°, $[\alpha]_D^{17°} + 15°$ in ethanol, which is clearly not identical with the 2 : 3-dimethyl galactose anilide, m.p. 130–131°, $[\alpha]_D^{15°} + 119°$ in ethanol of Robertson and Lamb[6]; the anilide is not particularly suitable as a derivative for characterizing this sugar since it is difficult to purify.

The dimethyl-γ-galactonolactone was converted into the phenylhydrazide, m.p. 140°, not depressed on admixture with a synthetic specimen which we received recently from Dr. D. J. Bell, and the crystalline dimethyl sugar suffered no depression of melting point on admixture with an authentic specimen supplied by him. Furthermore, we have prepared a crystalline dimethyl-β-methyl-galactoside, m.p. 72° $[\alpha]_D^{19°} - 22°$ in chloroform, and its 2 : 3-monoacetone derivative, m.p. 54°, the properties of which are in good agreement with those recorded by Dr. Bell[7] in his recent studies on synthetic dimethyl galactose. No doubt remains, therefore, that this dimethyl galactose isolated in crystalline form from a natural source for the first time is, in fact, 2 : 6-dimethyl-β-*d*-galactopyranose.

Since the rate of removal of sulphate from the hot extract with *N* sodium hydroxide at 100° is exceedingly slow (62 per cent in 3 days), it is concluded that the sulphate group is located on C_4[2,8] and that the galactopyranose residues are linked to adjacent units through C_1 and C_3. The absence of α-glycol groups is confirmed by the failure of the polysaccharide to react with periodic acid. It may be recalled that a similar structure for the galactose residues was proposed for the corresponding polysaccharide[2,8] isolated from *Chondrus crispus*, although in this instance owing to the difficulty of methylation no crystalline 2 : 6-dimethyl galactose was isolated.

No definite pronouncement can be made as yet about the non-galactosic moiety, but certain of its properties are not inconsistent with those of a keto hexonic acid; it may be recalled that 2-ketogluconic acid has been isolated recently from Irish moss by Young and Rice[9]. Further work is in progress on this question.

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Resistivity of Thin Metallic Films

IN continuation of work carried out in this Laboratory on the electric and magnetic properties of thin metallic films[1], we have now investigated the resistivity of nickel films (20 mμ–700 mμ) between − 236° C. and 400° C. The films are deposited on thin glass sheets by using cathodic sputtering in an atmosphere of hydrogen gas, carefully purified. We measured the electric resistance as a function of thickness and temperature below and above the Curie point. Between 0° C. and − 183° C., we found approximately a linear variation of the resistance with temperature. Below − 183° C. and also between 0° C. and the Curie point this is not the case. Above 358° C. the temperature coefficient of the resistance is again constant.

Like Colombiani[2], we found that below a certain thickness (for our films 40 mμ, while he finds as limit 220 mμ) the nickel films possess a negative temperature coefficient. This limit seems not to be greatly changed by sintering. Fig. 1 shows the average temperature coefficient, α, corresponding to the temperature region − 78° C. and 0° C. as a function of thickness.

We investigated specially the variation of the resistance in the neighbourhood of the Curie point. In Fig. 2, $(1/R_0)\,(dR/dT)$ is shown as a function of temperature. The curve for normal nickel has been computed from measurements made by Gerlach and

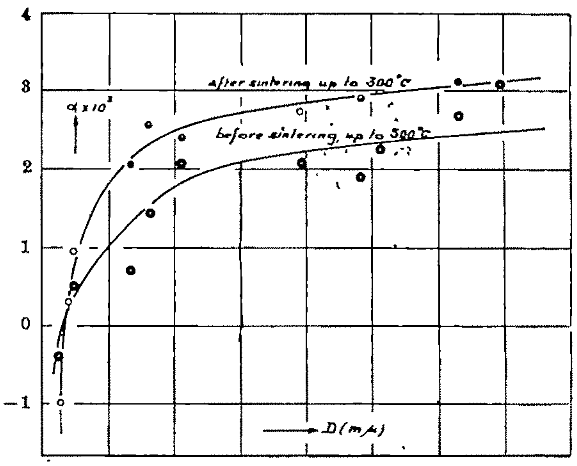

Fig. 1.

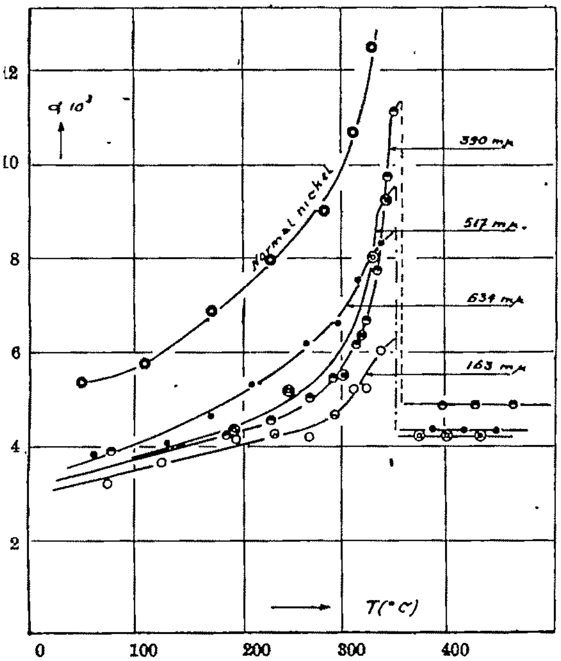

Fig. 2.

Schneiderhan[3]. The form of the curves obtained seems very difficult to interpret because two effects are concerned, namely, the dependency of the spontaneous magnetization on thickness, and secondly the behaviour of thin films as semiconductors.

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Performance of Diffusion Pumps

REPORTING recently on the vacuums produced by diffusion pumps, Ray and Sengupta[1] quote my statement "that the limit of pumping is set at the vapour pressure of the pump fluid at room temperature" and then proceed to take gentle issue with me. The correctness of my statement and of their counter-findings are, surely, both a matter of definition.

When the modern, rotary, oil-immersed mechanical pump was introduced, it was usual to place a charcoal or liquid-air trap in the vacuum circuit to obtain low pressures. Similarly the Gaede–Langmuir vapour pump required a vapour trap for proper operation. It thus became the practice to express the ultimate performance of all kinds of high-vacuum pumps as though they would be used with a cooled trap. Langmuir's contention[2] that his mercury pump could attain an indefinitely high vacuum with liquid air was as valid as the equally prevalent belief that the vacuum without the trap would be limited to about 2×10^{-3} mμ, which is vapour pressure of mercury at room temperature.

The situation was satisfactory to all parties until C. R. Burch[3] invented the phlegmatic oil-filling to replace mercury in a condensation pump. Pressures of 10^{-6} mm. were immediately available *without* a cooled trap. To compare the performance of an oil-filled pump with a mercury pump under trapped conditions was manifestly wrong since the whole point of the oil pump was to dispense with the trap. Unfortunately, the manufacturers of oil-sealed mechanical pumps and mercury diffusion pumps found it desirable to continue describing performance in conjunction with a trap, even though mechanical pumps are now generally used without a trap. Thus a well-known laboratory mechanical pump is advertised to produce an ultimate vacuum of 10^{-4} mm. (there is no mention of a trap) though the limit as measured by a Pirani, ionization or Knudsen gauge applied directly to the pump is about 8 microns.

Those of us whose programme required fast economical pumps found the oil-filled diffusion pump to merit the most intensive study. It was soon apparent that the vacuum available was a little poorer (higher pressure) than the vapour pressure of the operating fluid at room temperature. The degradation of vacuum was due to volatile impurities and products of decomposition. To circumvent these the self-purifying pump was devised. Such a pump, used under optimum conditions of construction and type of fluid, provides a vacuum which is almost exactly equal to the vapour pressure[4] of the main constituent of the fluid at the temperature of the entrance to the pump (usually room temperature). When Ray and Sengupta make a distinction between the vapour pressure of the fluid and the partial pressure of residual air, they tacitly accept my definition and at the same time provide a method of calculating the ultimate vacuum that would be available with a strongly cooled trap.

There are, of course, conditions where my statement would not hold. The definition applies to vapours generated at relatively low boiler pressures and ejected at slow speed through wide openings. This condition has hitherto been necessary with organic fluids to avoid decomposition. The multi-stage steam ejector does not suffer from these limitations, and manufacturers have succeeded in producing, with four or five stages and appropriate inter-condensers, 'blank off' pressures of 5–10 microns, which are about 5,000 times lower than the vapour pressure of water at room temperature. This must mean that the steam issuing from the final jet has been accelerated uniformly to such a speed and so thoroughly robbed of random motion that not one water molecule in many millions is guilty of 'back-streaming'.

The evolution of the high-vacuum pump is likely to continue for many years, and it would be rash to speculate on an ultimate design. The very large pumps required to maintain vacuums in the 'wet' system of heavy chemical industry—the molecular distillation of natural oils, for example[5]—employ many operating stages and subsidiary equipment and warrant the term 'vacuum engine' rather than pump.

Type of pump	Optimum speed (litres/sec.)	Ultimate vacuum untrapped (mm. Hg)	Watts input	Ratio, watts per litre/sec.
Mercury, single-stage, early American	10	$2\cdot5 \times 10^{-3}$	1500	150
Mercury, single-stage, early German	25	$2\cdot5 \times 10^{-3}$	400	160
Mercury, three-stage, recent German	20	$2\cdot5 \times 10^{-3}$	1800	90
Oil, single-stage, recent British	125	10^{-6}	1350	10·8
Oil, single-stage, recent American	220	5×10^{-6}	220	1·0
Oil, three-stage fractionating, recent American	1200	6×10^{-6}	1000	0·8

Evidently a small increase of efficiency of jet, boiler or fluid may have cumulative effects of considerable moment in reducing operating costs. Some idea of the trends in performance may be gathered from the accompanying table compiled by my associate, Mr. F. M. Jenner, for pumps of laboratory size that have been introduced during the past twenty years.

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[1] Ray, K., and Sengupta, N. D., *Nature*, 155, 727 (1945).

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Comparative Vacua Produced by Different Oils in a Diffusion Pump

In our previous communication[1] it was noted that the vapour pressure of the pump fluid affects the total vacuum only by a minor fraction, and the pump continues to exhaust air from the chamber to be evacuated to a pressure far below the vapour pressure of the fluid. A picture of the pumping action has also been suggested.

The practical independence of ultimate vacuum on a change of pump fluids has been studied in subsequent experiments[2]. Different types of fillings were used: Apiezon *B*, Capella *D* (Caltex), Mobile *B*, Petroleum jelly (white) and solid paraffin. They gave the same ultimate vacuum with a single-stage diffusion pump within the workable range of adjustments (see table). The increase of heat input with the petroleum jelly and solid paraffin fillings are worth mentioning. In these cases the flow of water had to be reduced in order to keep the body of the pump sufficiently warm.

The total pressure was measured by a Pirani gauge and the partial pressure by a McLeod gauge.

EFFECT OF PUMP FLUIDS ON THE PRODUCTION OF VACUUM BY A SINGLE-STAGE DIFFUSION PUMP (PRESSURE IN $\mu = 10^{-3}$ MM. MERCURY).

Pump filling	Vacuum conditions		Relative heat input (estimated)	Remarks
	Partial pressure of air	Partial pressure of fluid vapour*		
Apiezon oil	0·03	0·10	1	
Capella *D* (Caltex)	0·03	0·17	1·5	
Mobile *B*	0·03	0·97	1·5	
Petroleum jelly (white)	0·03	0·67	2	Water circulation is to be low enough to maintain fluidity and adequate boiling
Solid paraffin	0·03	0·57	2·5–3	,,

* This is, however, not the true vapour pressure of the fluid under static saturation condition, as the pressure is measured under constant pumping condition.

In another experiment solid paraffin was used in a three-compartment fractionating pump. The suction of air was not improved, but the back diffusion of fluid vapour was markedly reduced. With a single-stage pump it was 0·57 μ (see table), but with the three-compartment pump it came down to 0·06 μ. These experiments corroborate our picture of the working of a diffusion pump.

Our thanks are due to Prof. M. N. Saha for his interest in the work, and also to the authorities of the B.S.I.R. for a financial grant to carry out the investigation.

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[1] Ray and Sengupta, *Nature*, 155, 727 (1945).

[2] Ray and Sengupta, *Science and Culture*, 10, 560 (1945).

An Illusion of Size

In his letter, Mr. J. Phelps[1] refers to an interesting point in the manufacture of threepences, namely, their expansion in the coining press into dodecagonal steel collars. The fact that the corners of coins subsequent to 1940 are more rounded than are those of earlier ones seems to point to a change in the collars at about that date. If this is the case, it will also explain the change in the size of the coins which occurred at about the same time referred to in my letter[2].

The difference in size of the old and new issue is easily demonstrated with callipers, for if these are adjusted to be a tight fit on little-worn coins of the old issue they will be found to be quite loose on similar coins of the new one.

Mr. Phelps's statement that the edges of all coins become rounded in circulation is almost certainly correct, but I do not think that it accounts satisfactorily for the 'illusion', for the statement made by Dr. A. Loewenstein[3] was that it was the new coins which appeared to be the smaller, whereas according to Mr. Phelps it should be the old ones with worn edges which appear to be the smaller.

I feel that the word 'illusion' should not be used where actual differences of shape exist such as these. It should be reserved for cases where a faulty judgment has been made because of some defect in a sense-organ. All the familiar optical illusions come in this category.

When light is failing, and I am not wearing spectacles, I tend to confuse two-shilling pieces with half-crowns. This is an illusion which I find embarrassing. Would it be possible for one of these coins to be given the dodecagonal shape of the threepenny piece?

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[1] *Nature*, 156, 269 (1945).

[2] *Nature*, 156, 118 (1945).

[3] *Nature*, 155, 672 (1945).

To see if Prof. H. Hartridge's explanation[1] of the effect discovered by Dr. A. Loewenstein[2] was justified, the experiment described by them was repeated on a comprehensive scale. Four nickel threepenny bits coined in 1942 were selected and two of them had their edges and heads filed off* so that a flat surface was obtained on both. One coin of each pair was

* Permission to mutilate the coins was obtained from the Deputy Master and Comptroller of the Royal Mint.

olished to a high degree: special attention was paid o the regions near the edges being as bright as those near the centre. The other filed coin was brought into contact with 'Plasticene', which tarnished its urface immediately. This was more satisfactory than oxidation by heating, since the risk of deforming the oin was eliminated. The remaining coin was dull and needed no attention.

The filed and normal coins were placed in pairs on the same neutral background and illuminated by a parallel beam of light from a carbon arc. Four ilters were used: Ilford Nos. 204, 304, 404 (red, lue, green) and one neutral-tinted plate. Nineteen observers were told that the respective pairs consisted of reputedly equal coins, and each put down his esult for eight observations: four each for perpendicular and oblique illumination. All observations were carried out *along* the reflected beam.

It is found that, in the case of oblique lighting, the bright coin appears to be the larger in all cases except for the filed coins illuminated by neutral light. This general result is to be expected on account of rradiation. The observations for perpendicular ncidence are much less convincing: in the case of the filed coins, the dull appeared to be the larger in all except blue light, and there the difference is too small to defy confirmation. It is to be expected that the scales would tip in favour of the dull coin, since another set of experiments to be published in detail elsewhere demonstrated the independence of the effect on the colour of the filter. Moreover, in the instances where the dull coin in general appeared to be the larger, the filed coin showed the effect in a much more pronounced way than the normal threepenny bit. This is rather remarkable since perpendicular illumination might be expected sensibly to diminish the appearance of unevenness of the normal coin, as all shadows are greatly reduced.

The fact that the filed coin is much more effective n giving the illusion of size indicates that an explanation of the phenomenon may have to be rejected f it is based on the way light is reflected from the coins. This applies not only to Prof. Hartridge's note but also to that of Mr. Phelps[3].

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Nature, 156, 118 (1945).
Nature, 155, 672 (1945).
Nature, 156, 269 (1945).

Measurement of Ultrasonic Velocities in Extended Solids

FOR extended solids, the ultrasonic frequencies to be used for any reasonable propagation of the waves through them must be low, say, 500 kilocycles and less, for the vibrations of higher frequencies will be excessively damped. For determination of velocities at higher frequencies, a method based on the Debye–Sears ultrasonic diffraction of light has already been indicated[1], and in the following we will describe the method found for the lower frequencies.

Two quartz crystals, T and R, X-cut and of equal thickness, were attached to the opposite ends of a 3 ft. column (3 in. × 3 in.) of cement-sand concrete. The ultrasonic vibrations (frequency 300 kc./sec.) were sent by T and received by R after their propagation in the solid. The voltage developed at R by piezo-electric action was fed to the input of a vacuum-tube ultrasonic detector specially made for the purpose (employing two stages of radio-frequency amplification followed by one of rectification and one of D.C. amplification), such that the presence of an input voltage at the grid of the first valve gave a change in the steady plate-current of the last valve. The vibrations at T were produced by a conventional Hartley-type transmitting circuit. The voltages tending to reach the input of the detector were of two origins, one of ultrasonic origin from R, and the other due to the electromagnetic waves coming from the transmitting circuit. By exposing the screened lead coming from the crystal R, or exposing the grid of the first valve under controlled conditions, it could be arranged that the voltage due to the electromagnetic waves was much greater than that of ultrasonic origin, but not so much as to prevent the possibility of the indication of the latter. The change in the plate-current of the last valve of the ultrasonic detector was due to the vector sum of the two voltages, and by varying the frequency of the transmitting circuit (tuning of the detector system being adjusted simultaneously) through a small region, say, 5,000 cycles or less, so that the change of frequency did not go beyond the resonance region of the crystals, a maximum and minimum of the plate-current could be produced. Evidently the maximum occurred when both voltages were in phase, and the minimum when they were in antiphase. Now the phase of the electromagnetic waves reaching the ultrasonic detector was only negligibly changed, if at all, in this small variation of frequency due to their long wave-length (1,000 metres) as compared to the distance between the transmitting circuit and the ultrasonic detector (a few feet). So, for the minimum of plate current the phase of the voltage of ultrasonic origin had changed sign. This indicated that the number of ultrasonic wave-lengths in the solid column had changed by half a wave-length.

Let f be the length of the column, f_1 and λ_1 the frequency and wave-length for maximum current, and f_2 and λ_2 for minimum current, and v the velocity of ultrasonics, assumed the same for both frequencies. Then

$$l = n\lambda_1 = (n \pm \tfrac{1}{2})\,\lambda_2$$

or

$$l = n\frac{v}{f_1} = (n \pm \tfrac{1}{2})\frac{v}{f_2}.$$

From which

$$v = 2l(f_1 \sim f_2).$$

Taking v as about 6,000 m./sec., l as 2 ft., $f_1 \sim f_2$ is about 5,000 cycles/sec., which can be easily measured by modern technique.

The region of resonance frequencies of the quartz can be easily made to contain this frequency interval, as was the case in our experiments. For lower frequencies, the thickness of the quartz is comparable to its other dimensions, and so by the coupling of the different resonance frequencies, the resonance frequency region is made sufficiently broad.

It is hoped to publish the full details of the apparatus and the quantitative results obtained in due course.

R. PARSHAD.

Physics Laboratory,
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Lahore.

July 12.

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[1] Parshad, R., *Curr. Sci.*, 13, 14 (1944).

FRIEDEL-CRAFTS CATALYSTS AND POLYMERIZATION

A CONFERENCE on "Friedel-Crafts Catalysts and Polymèrisation" was held on Saturday, September 15, in the Chemistry Department of the University of Manchester. This Conference was convened by Prof. M. Polanyi, and some hundred and seventy academic and industrial research workers were present. In welcoming the guests, Prof. Polanyi said that similar meetings on a smaller scale had been held previously at the Universities of Manchester and Leeds, but that this was the first large-scale meeting of its kind, in which the subject under discussion was of such general interest to both academic and industrial research workers. He hoped that further conferences of a similar nature would be held.

The first part of the discussion was concerned with the physical chemistry of the Friedel-Crafts catalysts. Dr. F. Fairbrother, in a paper on "The Catalytic Halides", discussed the reasons for the catalytic activity of these halides, and the way in which their catalytic power is exercised. One of the outstanding features of these Friedel-Crafts catalysts is that they are all electrophilic in character, and Dr. Fairbrother described two kinds of experimental investigation by which a comparison of the electrophilic character of inorganic halides may be made. The first was the study of the exchange of radioactive bromine between an organic bromide and an inorganic bromide. From these experiments it was found that the ease of halogen exchange could be correlated with the catalytic activity of the inorganic bromide on one hand, and with the ionizability of the organic bromide on the other hand. This exchange of radio-bromine must mean that the interaction of the inorganic bromide with the organic bromide causes the original C—Br bond to break. This was discussed in terms of the reaction:

$$M\,\mathrm{Hal}_n + R\,\mathrm{Hal} \rightleftarrows (M\,\mathrm{Hal}_n \,.\, R\,\mathrm{Hal}) \rightleftarrows M\,\mathrm{Hal}^-_{n+1} + R^+.$$

That is, the exchange may take place through the formation of an ion pair, the partners of which are able to rotate relative to one another, so that on disengagement and reformation of neutral molecules an exchange of halogen atoms may have taken place. If a polar but un-ionized addition compound is formed, the actual exchange of bromine atoms, it was suggested, could only occur by the rupture of such an addition compound. In the second experimental investigation which Dr. Fairbrother described, dielectric polarization measurements were carried out on solutions containing a metallic bromide and an organic bromide to determine the equilibrium concentration of ion pairs. This equilibrium concentration was found to be very small in general, as had been predicted from a consideration of the endothermicity of the process. These findings were also confirmed by measurements of the dielectric polarization and colour of metal halide – triphenylmethyl halide double compounds.

Dr. H. A. Skinner spoke on "The Molecular Structures of the Catalytic Halides". He summarized the results of electron diffraction studies of the halides of Groups II, III, IV and V of the Periodic Table. These results showed that, in general, the metal – halogen bond distances are shorter than those which would be expected if the bonds were of the normal covalent type. For those metal halides known to show catalytic activity in Friedel-Crafts reaction the most active catalysts show a greater percenta bond-contraction than do the weaker catalysts. Th fact that the silicon halides are not catalyticall active although they show a marked bond co traction was considered in relation to the low dipo moment of the Si—Cl bond, and the suggestion w made that one of the factors upon which the catalyt activity of the halide $M-X$ depends is the ion nature of the bond in the sense $M^+ X^-$.

Thermochemical calculations were given for th interaction of the catalyst and the organic halid for the case of boron trifluoride and organic fluorid The three reactions

(a) $CH_3F + BF_3 \rightarrow CH_3^+ [BF_4]^-$
(b) $(CH_3)_3CF + BF_3 \rightarrow (CH_3)_3 C^+ [BF_4]^-$
(c) $(Ph)_3 CF + BF_3 \rightarrow Ph_3 C^+ [BF_4]^-$

were examined, and the conclusion was reached tha reaction (a) is endothermic and unlikely to occu whereas reactions (b) and (c) are exothermic, an probably will occur. These results were compare with the experimental observations of Burwell an Archer that the tertiary alkyl fluorides more readil undergo Friedel-Crafts reactions in the presence boron trifluoride than do the primary alkyl fluoride and with the fact observed by Wiberg, that tr phenylmethyl fluoride readily forms a complex wit boron trifluoride.

Dr. P. H. Sykes, in a paper on "Friedel-Craft Catalysts in Carbon-Monoxide Reactions", discusse the addition of carbon monoxide to ethers, alky halides, alcohols and aromatic hydrocarbons usin aluminium chloride, boron trifluoride, hydroge fluoride and sulphuric acid as catalysts. Dr. Syke discussed the formation of complexes between th catalyst and the reactants and between the catalys and the products, and suggested that in many case the effectiveness of the catalyst is due to the fac that the decrease in free energy from catalyst reactant complex to catalyst-product complex is mor marked than the decrease in free energy of th reaction in the absence of catalyst. It was suggeste that this is the reason why aluminium chlorid catalyses the production of benzaldehyde from benzen and carbon monoxide, a reaction for which, in th absence of catalyst, there is an increase of free energ of 5 kcal./mole. Evidence was brought forward t show that the aluminium chloride – product com plexes are more stable than the corresponding boro trifluoride complexes, so that if, in the absenc of catalyst, a reaction is thermodynamically un favourable, aluminium chloride has a very gre advantage over boron trifluoride as a catalyst fo that reaction.

As regards the mechanism of these reactions, D Sykes gave evidence for the presence of HCOCl a an intermediate in the reactions catalysed by alum inium chloride. The activation of the other reacta molecule was considered for the case of the formatio of *iso*-butyric acid from carbon monoxide and pr panol. The fact that both normal propanol and *is* propanol react with carbon monoxide to for *iso*-butyric acid suggests that the reaction procee through the formation of an intermediate carboniu ion, since carbonium ions are known to be easil rearranged.

Dr. A. G. Evans read a paper on "Low Temperatu Polymerization" by A. G. Evans and M. Polany The polymerization of *iso*-butene catalysed by boro trifluoride is of great interest because it occurs wit xplosive violence at low temperatures. Owing to e difficulties of studying the kinetics of the *iso*utene polymerization, these authors decided to udy the boron trifluoride catalysed reaction of di-obutene, C_8H_{16}. Under the catalytic influence of oron trifluoride, di-*iso*butene reacts quite readily, ut yields nothing of higher molecular weight than $_{16}H_{32}$. The fact that di-*iso*butene does not polyerize under these conditions, whereas *iso*butene oes, was discussed in terms of steric hindrance. It as shown that steric hindrance in the polymer moleule, which is appreciable even when the monomer *iso*butene, would be prohibitively large for the case f di-*iso*butene. Thus it was assumed that the mechnism of the di-*iso*butene reaction is the same as that f *iso*butene; the absence of a polymerization rection in the case of di-*iso*butene was attributed olely to steric reasons.

To account for the kinetic results obtained, the ossibility of an energy chain-mechanism was disussed. It was suggested that the initiation of the nergy chain is due to the reaction of boron trifluoride ith some component *X*, of which only a trace is resent, to give BF_3X^*, a hot molecule, the energy f formation of which has not been dissipated into hermal energy. In this way, one molecule of the omponent *X* may be effective in causing the rection of many di-*iso*butene molecules. This mechnism would lead to products having a structure imilar to that found for the actual products by infraed examination. It is found that $C_{16}H_{32}$ is not the nly product of the reaction; appreciable quantities f $C_{12}H_{24}$ are also produced. This suggests that the $_{16}H_{32}$ molecules may be capable of disruption nd thus supports the idea of an energy chainmechanism.

Polymerization in the gas phase was discussed by rof. H. W. Melville in a paper on "The Mechanism f Polymerization of Vinyl Compounds". Prof. elville discussed two ways of inducing polymerizaion reactions in the vapour phase: (*a*) by methyl adicals or hydrogen atoms, and (*b*) by photoactivaion. In the case of methyl methacrylate, these two nethods of initiating polymerization chains give rise o reactions which have entirely different kinetics. The most striking difference is that the photoactivated olymerization proceeds in the dark long after the ight is switched off, whereas in the case of the polynerization initiated by free radicals the life-time is f the order of a few milliseconds.

Prof. Melville gave an account of very interesting xperiments on the photopolymerization of vinyl acetate. In the vapour phase the reaction-rate is ressure-dependent, but there is a critical pressure elow which no polymerization occurs. To explain hese results it must be assumed that the photoactivated vinyl acetate molecule may lose its energy pontaneously, that is, in a collision-free process. onfirmation of this hypothesis comes from the fact hat inert gases inhibit the reaction, not by reacting vith the growing polymer, but by interaction with he initially excited vinyl acetate molecules before olymerization starts. This direct photo-polymerizaion is found to be quite a different reaction from that which occurs when the polymerization of vinyl acetate s induced by free radicals.

Prof. Melville described the method by which he as evaluated the individual velocity constants, k_p and k_t, for the propagation and the termination eactions in the vinyl acetate polymerization. By btaining values of the propagation constant at various temperatures, it was found that the activation energy for the propagation reaction is 4,400 cal. and the temperature independent factor is $1 \cdot 48 \times 10^5$ l. mol.$^{-1}$ sec.$^{-1}$ (which means a steric factor of 10^{-6}). For the termination reaction it was found that the activation energy is zero and the temperature independent factor is $2 \cdot 47 \times 10^9$ l. mol.$^{-1}$ sec.$^{-1}$ (which corresponds to a steric factor of 10^{-2}). These experiments have been repeated at double the chain-length, and the results obtained show that the propagation constant k_p decreases only slightly as the molecular size is doubled, and that the ratio $k_p/k_t^{1/2}$ is, to a good approximation, independent of molecular size.

Prof. M. G. Evans concluded the second half of the discussion by reading a paper on "Energy Transfer in Chemical Reactions". Prof. Evans considered the theoretical calculation of steric factors for the propagation and termination reactions of polymerization, and compared the values obtained in this way with those found experimentally by Prof. Melville. He showed that the steric factor for propagation given by the transition state theory is of the same order as that which is found experimentally. In the case of termination reactions, however, the theory is unable to interpret the experimental results. He suggested that the possibility of an energy chain (in which the growing polymer molecule is always energetically active at the terminal double-bond) might be understood if it be assumed that an active double-bond is one that is in the triplet state. In this case the resonance requirements in the transition state for the addition of a molecule of monomer to the end of an active polymer may result in the double-bond of the added monomer being converted into the triplet state, and thereby activated.

A. G. Evans.

IMPEDANCE BRIDGE WITH A 10^9 TO 1 RANGE

For measuring the impedances of a wide variety of coils used in electronic and communication apparatus the Bell Laboratories have designed a wide-range audio-frequency bridge, and a carrier-frequency bridge, about twenty-five of which have been constructed for the various manufacturing plants of the Western Electric Company. The bridges have been described in an article by H. T. Wilhelm (*Bell Lab. Rec.*, 23, No. 3; March 1945).

The audio-frequency bridge can measure inductance from one microhenry to 1,000 henrys, and resistance from 0·001 ohm to 1 megohm. This extremely wide range is secured by providing six component ranges, any one of which may be selected by operating a single range dial. Depending on the position of this dial, the normal reading of the bridge is multiplied by 0·01, 0·1, 1·0, 10, 100, or 1,000. The frequency range of the bridge is from 20 to 10,000 cycles. One arm (*AB*) includes a conductance and a capacitance standard in parallel, each controlled by four dials. A six-position range dial selects resistors for the two resistance arms (*BC* and *AD*) that will result in the desired multiplying constant. Six resistors in the *AD* arm and three in the *BC* arm are used for this purpose. The inductance component of the impedance under test is determined by the capacitance standard, and four dials which control this standard are marked directly in terms of inductance, ranging from steps of 0·1 henry at the left to 0·0001 henry at the right. The latter dial gives continuous control of the standard, and thus values may be estimated to one tenth of a step or 0·00001 henry.

The carrier-frequency bridge is almost identical in appearance with the audio-frequency bridge. It covers the frequency range 20–150,000 cycles and differs from the audio-frequency bridge principally in the detector transformers, and in the capacitance and conductance standards. The carrier capacitance decade steps are one tenth those of the audio bridge, and the carrier conductance decade steps are ten times those of the audio bridge. It is designed for test potentials up to 100 volts and currents up to 0·2 amp. A greater assortment of zero-impedance compensators is provided to permit zero balances to be made for all measurements. The accuracy of measurement for both audio and carrier bridges is of the order of 0·25 per cent for the major component of the impedance, and a slightly wider limit of accuracy is attained for the minor component.

Without changing its size or general appearance, it was found possible by the addition of a few circuit elements to adapt this bridge to measurements of capacitance as well as of inductance. Such a bridge therefore is also available in both the audio-frequency and carrier-frequency range. Inductances are measured exactly as with the bridge described above; but for capacitance measurements, the circuit is changed to a ratio-arm comparison bridge.

In designing the wide-range impedance bridge, it was found that no detector was available that would operate over the desired range of frequency and give the high sensitivity needed, and still be suitable for use in manufacturing plants where sizes, ruggedness and easy manipulation are of prime importance. It was therefore decided to employ a cathode-ray detector, which has certain advantages where many similar units must be tested. An additional amplifier and detector tube was also incorporated, connected to a meter jack to provide for situations where it might be desired to use a meter indication. Two detectors were made, one for the audio range and one for the carrier range, and these are described in an accompanying article by E. H. Eveland.

With an A.C. bridge, the signal delivered to the detector will in general contain a number of components in addition to the fundamental frequency of the oscillator. These may be harmonic frequencies of the oscillator, harmonics generated by the non-linear characteristics of the unknown, and noise picked up or generated by the system. The oscillator fundamental is balanced out by the bridge; but if a good null detection is to be obtained, provision must be made for eliminating or greatly decreasing the undesirable components. To avoid the use of filters, feedback amplifiers are employed in the detector to reduce all components but the oscillator fundamental.

In the circuit employed for the new detector, a buffer amplifier receives the output from the bridge and has sufficient feedback to prevent cross-modulation of the harmonics that would generate the oscillator frequency as a component in its output. From this amplifier the signal passes through a three-stage amplifier with selective feedback that gives at least 40 db. greater gain for the fundamental than for any other component present. From this feedback amplifier, the signal passes to a single-stage amplifier with automatic volume control, and thence to the vertical plates of the cathode-ray tube. A connexion is also carried from the automatic volume-controlled amplifier to another amplifier and detector to supply an indicating meter when one to be used instead of the cathode-ray tube. To suppl the horizontal plates of the cathode-ray tube, a sign from the oscillator is first passed through an invert to change the unbalanced output of the oscillator t the balanced input required by the cathode-ray tub The output of the inverter is then carried through phase-shifting network, and thence through a amplifier to the horizontal plates of the cathode-ra tube. The network permits the phase of the voltag applied to the horizontal plates to be shifted relativ to that applied to the vertical plates so that an ellips is obtained on the cathode-ray tube. The use of automatic volume control avoids the need of frequentl adjusting the detector gain as the bridge is bein balanced, and it greatly expedites the work when no even the approximate value of the coil under test i known.

While the bridge is unbalanced, the image on th cathode-ray tube is an ellipse with the shorter axi proportional to the resistance unbalance, and wit the angle between the longer axis and the horizonta axis of the tube proportional to the inductance unbalance. The size of the angle made by the longe axis of the ellipse indicates the amount of the unbalance, while the direction of unbalance is indicate by this angle being above or below the horizontal At balance, the ellipse collapses to a horizontal line

One of the purposes in designing the new detecto was to permit rapid tests to be made, or large number of similar coils having nominal values of inductanc and resistance which must be met within certai limits to be acceptable. To determine quickl whether or not the coils meet the requirements, thin cellulose acetate plate marked with limiting line is placed over the end of the cathode-ray tube. Th bridge dials are set to the nominal values of inductanc and resistance of the coils, which are then connecte to the bridge, one after another, and, if the ellipse appearing on the tube lie within the acceptance value as indicated, the coils are accepted. The two detector available are similar in appearance and circui arrangement, but one covers the frequency rang 20–20,000 cycles and the other 200–200,000 cycles Twenty of these bridge-detector units are now in us for testing coils in the various manufacturing plant of the Western Electric Company.

VOLCANOLOGICAL STATION OF KAMCHATKA

A BRIEF report by V. I. Vlodavetz on the activit of the volcanological station of Kamchatk (*Bull. Acad. Sci. URSS.*, Sér. Géol., No. 1, 40 1945) provides some interesting information regarding this little-known volcanic region. About 40 pe cent of the total surface of Kamchatka is occupie by Quaternary and Recent lavas and tuffs, and a the present time the total number of known volcanoe is 129, of which twenty are either active or dormant There are also sixty-eight groups of thermal spring and seventeen large geysers. The volcanoes ar arranged along two belts, one extending 700 km along the eastern margin of the peninsula, the othe along the middle ridge. The most prominent activ volcano is Klyuchevskaya Sopka, which during th last two hundred and forty years has erupted fift times.

asual observations of Kamchatka's volcanoes gan in the first half of the eighteenth century, t it is only since 1931 that a systematic study has n made, beginning with the publication of a report the Avacha volcano by A. N. Zavaritzky. In 35, through the initiative of F. Y. Levinson-ssing, a volcanological station was built in the inity of Klyuchevskaya Sopka. After the death Levinson-Lessing in 1939, the station was directed A. N. Zavaritzky, who is now organizing a special lcanological Laboratory in Moscow. The principal rposes of the Volcanological Station are systematic servation of volcanic activity, the study of volcanic oducts such as lavas, ashes, gases and sublimates, d the study of thermal springs and geysers. The ation consists of several buildings, including chem- l and petrographical laboratories, library and ing quarters, and is staffed by a number of servers who have at their disposal horses in the mmer and sledge-dogs in the winter.

The principal observations made at the Station fer to Klyuchevskaya Sopka. During the last ten ars, it has had two periods of eruptive activity: ugust–October 1935 and April 1937–March 1939. he total volume of lavas and ashes erupted amounted 437 millions cubic metres. A rough calculation ows that the volume of the present cone corresponds the product of seven hundred eruptions of equal tivity, and the estimated age of the volcano is five ousand years. Another interesting observation ade during the last stage of volcanic activity relates the composition of lavas. The lavas erupted at the wer level correspond to olivine-basalts, and those om the upper level to andesite-basalts; this ggests a gravitational differentiation within the lcanic pipe.

A remarkable feat was achieved by V. F. Popkov d I. Z. Ivanov, who, perched for one hour on a ating raft of solid lava, drifted along the flowing va for a distance of 2 km. During this drift they ere recording the temperature of the lava and llecting samples of gases. The recorded temperares of the flowing lava varied between 870° and 0° C., and the amount of gases in the lava was ry high. According to Popkov, 196 million cubic etres of gases (mainly steam) were emitted by lyuchevskaya Sopka during the intensive phase of tivity, while the neighbouring crater of Bilukay as emitting 1,200,000 cubic metres per hour. ccording to S. I. Nabokov (*Bull. Acad. Sci. URSS.*, r. Géol., No. 1, 501; 1945), the volcanic gases consist mainly of steam with variable amounts of hydroloric and hydrofluoric acids, sulphur dioxide, carbon onoxide and dioxide, methane, ammonia, hydrogen, ygen and nitrogen. The fumaroles can be subivided into two main groups, chloridic and sulphic, and the first group in its turn can be subdivided to (1) hydrous (800°), (2) halitic (500°), (3) mixed 00°–800°), (4) ammoniac (300°) and (5) fluorine elow 200°). Altogether forty-six chemical elements ve been recorded among the volcanic sublimates, well as several new minerals as yet unidentified.

It has recently been reported that Shiveluch, the ost northerly volcano in Kamchatka, has begun upting. A pillar of incandescent gases rising to a ight of two miles and at night visible thirty miles way has already been reported.

The results of observation of Kamchatka's volcanic tivity are now published in the *Bulletin of the olcanological Station on Kamchatka*, which began iblication in 1937, as well as other periodicals. In the *Bulletin of the Russian Geographical Society* of 1932, a map of volcanoes was published by N. G. Kell and a catalogue of volcanoes by P. T. Novograblenov. Among A. N. Zavaritzky's works dealing with Kamchatka, the most important are those relating to the rocks of Klyuchevaskaya Sopka (1931), to the northern group of volcanoes (1935) and the Avacha volcano (1935).

S. I. TOMKEIEFF.

REORGANIZATION OF MUSEUMS IN FRANCE

OF considerable interest is a short article entitled "Museum Reorganization in France", which appears in the *Museums Journal* of September (pp. 95–96). It reports the adoption of a scheme for the extensive reorganization of the art, history, and archæological museums of that country. The scheme will operate under the new Directorate of Arts and Letters which (by order of the French Minister of Education) has now replaced the former Directorate of Fine Arts. The development of the new Directorate (under M. Jacques Jaujard) will include the national museum service (hitherto known as "Musées nationaux"). In future, this service is to be known as "Musées de France", and it will be responsible for not only the six departments of the Louvre, the Palais de Tokio, the Jeu de Paume, the Guimet and Rodin Museums, and the museums of Cluny, Versailles, Saint-Germain, Compiègne, Sèvres, Malmaison, Fontainebleau, Pau, etc., as in the past (under its former designation), but also for all the provincial art museums. The object of this is the improvement of provincial museum collections, and the extension to those institutions of modern museum methods. A General Inspectorate of Museums, under the control of the Director of French Museums, will ensure maintenance of efficiency in these respects. In addition, the provincial museums are to be divided into two categories: (1) designated museums, and (2) controlled museums. The former will comprise the more important institutions (the curators of which will be Government officials), and the latter the smaller museums, the officials of which will remain municipal employees. In the first case the payment of salaries will be shared between the State and the municipalities concerned; in the second case, presumably, there will be no State grant in respect of salaries, but the Government will reserve the right of selecting candidates, and these, as a rule, will be required to hold the higher diploma of the École du Louvre.

It is made clear that these developments do not mean the nationalization of French museums; but they do mean that, from now on, the Government will exercise new powers over them with the view of their improvement and development. Scientific museums (those of natural history, chiefly) are not specifically mentioned in the plan, but their coordination with those that are specified is ensured in view of the fact that they are represented on various commissions, and that the French association of curators of public collections covers those commissions concerned with both types of museums.

Other branches of the new Directorate of Arts and Letters will deal with libraries, archives, etc., drama and music, and literature, and "another great department will be that of Architecture, including town planning and reconstruction".

FORTHCOMING EVENTS

*(Meeting marked with an asterisk * is open to the public)*

Saturday, November 24

Institution of Mechanical Engineers, Graduates' Section (at Storey's Gate, St James's Park, London, S.W.1), at 3 30 p.m.—Mr. A. C. Hartley: "Operation PLUTO" (Annual Lecture).

Monday, November 26

Royal Society of Arts (at John Adam Street, Adelphi, London, W.C 2), at 1 45 p.m.—Dr. F. C. Bawden: "Virus Diseases of Plants", 2. "The Spread of Virus Diseases" (Cantor Lectures)

Institution of Electrical Engineers (at Savoy Place, Victoria Embankment, London, W C.2), at 5 30 p.m—Discussion on "Standardization of Ripple Control" (to be opened by Mr. T. R. Rayner).

Society of Chemical Industry (joint meeting of the Plastics Group with the Institution of the Rubber Industry, in the Great Hall, Caxton Hall, Victoria Street, London, S.W 1), at 6.30 p m. —Mr. S. J. Skinner· "Synthetic Polymers in the War Effort".

Chemical Society, Yorkshire Section (in the Chemistry Lecture Theatre, The University, Leeds), at 6.30 p.m.—Prof. E. D. Hughes. "Substitution" (Tilden Lecture).

Royal Geographical Society (at Kensington Gore, South Kensington, London, S.W.7), at 8 p m.—General Sir William Platt. "The Geography of the Campaign in Eritrea and Northern Ethiopia".

Tuesday, November 27

Society of Chemical Industry, Agriculture Group (in the Physics Lecture Theatre, Royal College of Science, Imperial Institute Road, London, S.W 7), at 2.30 p.m.—Mr. D. H. F. Clayson: "The Chemistry of Composts".

Royal Anthropological Institute (at the Royal Society, Burlington House, Piccadilly, London, W 1), at 5 p m.—Prof. A. R. Radcliffe-Brown: "Religion and Society" (Henry Myers Lecture).

Royal Institution (at 21 Albemarle Street, London, W 1), at 5.15 p m.—Dr. Kathleen Lonsdale, F.R.S.: "Recent Research Work in the Davy Faraday Laboratory", (ii) "Divergent Beam X-Ray Crystallography".

Institution of Electrical Engineers, Radio Section (at Savoy Place, Victoria Embankment, London, W.C 2), at 5 30 p m—Discussion on "Film Forming Materials used in Insulation" (to be opened by Mr. C. R. Pye).

Quekett Microscopical Club (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 6 p m—Gossip Meeting; Mr. F. E. J. Ockenden: "Illuminants and Illumination".

Society of Chemical Industry, the Royal Institute of Chemistry, and the Chemical Society (joint meeting of the Edinburgh and East Scotland Sections with the Edinburgh University Chemical Society, in the Biochemical Lecture Theatre, Teviot Place, Edinburgh), at 7 p.m.—Prof. G. D. Preston· "The Structure and Chemistry of Metallic Crystals".

Sheffield Metallurgical Association (at 198 West Street, Sheffield 1), at 7 p.m.—Dr. R. Hunter: "Some Problems on the Heat Treatment of Steel".

Iron and Steel Institute (joint meeting with the Lincolnshire Iron and Steel Institute, at the Scunthorpe Technical School, Cole Street, Scunthorpe), at 7.30 p.m.—Dr. H. L. Saunders and Dr. H. J. Tress "Sinters and Sintering", Part 1.

Wednesday, November 28

Royal Society of Arts (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. James Agate: "A Moment in the History of the English Theatre" (Peter Le Neve Foster Lecture)

Institute of Physics, Electronics Group (at the Royal Institution, 21 Albemarle Street, London, W.1), at 5.30 p m.—Mr. A. J. Maddock: "Dielectric Heating".

Institute of Welding (at the Institution of Civil Engineers, Great George Street, London, S W.1), at 6 p.m.—Dr. H. O'Neill· "Metallurgical Features of Welded Steel".

Society of Public Analysts and other Analytical Chemists, Physical Methods Group (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 6 p m.—Annual General Meeting: Mr. R. C. Spiller: "The Barker Index—a Means of Identifying Crystals from their Shape"; Dr. M. W. Porter and Dr. A. E. J Vickers: "Examples of the Utility of the Barker Index in Analytical Chemistry".

British Institution of Radio Engineers (in Reynolds Hall, College of Technology, Sackville Street, Manchester), at 6.15 p.m.—Discussion on the Radio Industry Council Report on "Post-War European Broadcasting".

Royal Institute of Chemistry, Tees-side Local Section (at the Wm. Newton School, Norton, Stockton-on-Tees), at 7 15 p.m.—Mr. A. L. Bacharach. "Recent Developments in Vitamin Biochemistry".

Thursday, November 29

Chadwick Public Lecture (in the Sir Edward Meyerstein Lecture Theatre, Westminster Hospital Medical School, 17 Horseferry Road, London, S.W.1), at 2 30 p.m.—Dr. Archibald M H. Gray· "Some Social Aspects of Industrial Dermatitis" (Malcolm Morris Memorial Lecture)*.

Chemical Society (joint meeting of the Nottingham Section with the University College Physical and Chemical Society in the Chemistry Lecture Theatre, University College, Nottingham), at 4 p.m.—Prof. W. Wardlaw: "Structural Inorganic Chemistry".

Royal Institution (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Sir James Jeans, O M., F.R.S: "Physical Astronomy", (i) "The Cold Matter of the Planets".

Association for Scientific Photography (at the Alliance H Westminster, London, S.W.1), at 6.30 p.m.—Mr. Alan G. Sab "Some Notes on Illumination in Photomicrography".

Society of Chemical Industry, East Midlands Section (at Corporation Gas Theatre, Nottingham), at 7 p.m.—Mr. W. Wilso "Electronics with special reference to Detection, Measurement a Microscopy".

Friday, November 30

Royal Institution (at 21 Albemarle Street, London, W.1), 5.15 p.m.—Sir Nelson Johnson, K.C.B.: "Recent Advances Meteorological Methods".

Institution of Mechanical Engineers (at Storey's Gate, James's Park, London, S.W.1), at 5.30 p.m.—Discussion on "Pist and Piston Rings" (to be opened by Mr. J. S. Courtney-Pratt, G. K Tudor and Dr. B. Pugh).

North-East Coast Institution of Engineers and Shipbuild (in the Lecture Theatre, Mining Institute, Newcastle-upon-Tyn at 6 p m.—Dr. R. S. Silver and Mr. J. A. Mitchell. "Flow of Boil Water through Tubes and Orifices".

APPOINTMENTS VACANT

Applications are invited for the following appointments on before the dates mentioned.

Teacher of General Engineering Subjects (including El trical) at the Bootle Municipal Technical College and Boys' Second School (Trinity)—The Director of Education, Town Hall, Boo (November 30).

Chief Electrical Engineer to the Hammersmith Metropolit Borough Council—The Town Clerk, Town Hall, Hammersmith, L don, W.6 (November 30)

Assistant Lecturer in Physics—The Registrar, Municipal Coll of Technology, Manchester (November 30).

Head of the Department of Mathematics and Physics, He of the Department of Pharmacy, a Lecturer in Electric Engineering (preferably with teaching and industrial experienc a Lecturer in the Department of Mathematics and Physi and a Lecturer in Chemistry (able to teach Organic Chemistry Degree standard)—The Registrar, Municipal College, Portsmou (December 1).

Laboratory Steward in Biology in the Department of Che istry and Biology—The Clerk to the Governors, South-East Es Technical College and School of Art, Longbridge Road, Dagenha Essex (December 1).

Assistant Lecturer (woman) in Chemistry and Tutor Women in the Bradford Technical College—The Director of Educatio Town Hall, Bradford (December 1)

Assistant Librarian—The Registrar, University College, Nottin ham (December 3)

Junior and Senior Physicist for research on electronics, a Junior and Senior Physicists or Engineers for work on hig frequency and vidio-frequency circuits, by Research Laborator engaged mainly on Television—The Ministry of Labour and Nation Service, Appointments Department, Technical and Scientific Regist Room 670, York House, Kingsway, London, W.C.2, quoting A.1121.X (December 4).

Waterworks Engineer and Manager—The Clerk to the Spaldi Urban District Council, 11 Market Place, Spalding, Lincs. (December

Civil Engineers (two) by the Government of Iraq for the Direct ate General of Irrigation—The Ministry of Labour and Natio Service, Appointments Department, Technical and Scientific Regist Room 670, York House, Kingsway, London, W.C 2 (December 7).

Statistician in the Department of Preventive Medicine—T Secretary, Welsh National School of Medicine, 10 The Parade, Card (December 8).

Engineer and Manager of the Nottingham Corporation G Undertaking—The Town Clerk, The Guildhall, Nottingham, endors 'Engineer and Manager, Gas Undertaking' (December 15)

Lecturer in Charge, Sheep and Wool Department, Sydn Technical College—The Acting Official Secretary, New South Wa Government Offices, 125 Strand, London, W.C.2 (December 31).

Lecturer in Coal Utilization and Fuel—The Secretary, T University, Edmund Street, Birmingham 3 (December 31).

Lecturer in Civil Engineering (Ref. No. E.3025.XA), and Lecturer (permanent) and a Lecturer (temporary, two yea (Ref. No. C 2924 A), in the University of Cape Town—The Minist of Labour and National Service, Appointments Department, Techni and Scientific Register, Room 670, York House, Kingsway, Lond W.C 2, quoting the appropriate Ref. No. (January 12)

Lecturer in Geography in the University of Cape Town—T Ministry of Labour and National Service, Appointments Departme Technical and Scientific Register, Room 670, York House, Kingswa London, W C.2, quoting F 5188.A (January 12).

Civil Engineer by British Contractor to take charge of section large construction job in Middle East—The Ministry of Labour a National Service, Appointments Department, Technical and Scient Register, Room 670, York House, Kingsway, London, W.C 2, quoti E 3009 XA (January 12).

Secretary to the Curators of the University Chest—The Secreta to the Curators of the University Chest, Oxford (January 31)

Lecturer in Histology, a Lecturer in Pharmacology, Lecturer in Embryology, and a Lecturer in Civil Engineer —The Secretary, Queen's University, Belfast (March 31).

Assistant in the Department of Economics for Milk Co Investigation work—The Secretary, South-Eastern Agricultu College, Wye, Ashford, Kent.

Lecturer (temporary) in the Civil and Mechanical Enginee ing Department, for courses leading to the London Univers Degree, with Structures as one of the main subjects—The Secreta Woolwich Polytechnic, Woolwich, London, S.E.18.

NATURE

No. 3970 SATURDAY, DECEMBER 1, 1945 Vol. 156

CONTENTS

Page
State Scientific Service in Britain 643
istotle's Criticism of Platonism. By Prof. A. E. Taylor, .B.A. 647
vanced Mathematics. By Prof. H. T. H. Piaggio, .R.S. 648
hysical Theory of the Solar Corona. By Dr. A. Hunter 649
e City and Guilds College: Engineering at the mperial College. By Prof. E. F. D. Witchell . . 650
e Unity of Science 652
ective and Ineffective Strains of Legume Nodule acteria. By Dr. H. G. Thornton, F.R.S. 654
ituaries :
  Prof. E. J. Williams, F.R.S. By Prof. P. M. S. Blackett, F.R.S. 655
  Prof. Marc Tiffeneau. By Prof. Alex. McKenzie, F.R.S. 656
ws and Views 657
tters to the Editors :
  Propagation and Termination Coefficients for Vinyl Acetate Photopolymerization.—G. M. Burnett and Prof. H. W. Melville, F.R.S. 661
  Structure of Kaolinite.—Dr. G. W. Brindley and Keith Robinson 662
  Splitting of the Sodium Doublet Lines.—Prof. N. R. Tawde, B. S. Patil and G. K. Mehta 662
  Enhancement of the Action of Immune Hæm-Agglutinins by Human Serum.—K. E. Boorman, B. E. Dodd and Dr. W. T. J. Morgan 663
  Transition of Fibrinogen to Fibrin as a Two-Step Reaction.—Dr. K. Laki and Dr. W. F. H. M. Mommaerts 664
  Effect of Restriction of Food Intake upon the Incisor Teeth of Rachitic Rats.—Prof. J. T. Irving . . 664
  Utilization of the Slipper-Limpet (*Crepidula fornicata*) as Food as an Aid to the Recovery of Oyster-Culture in the Thames Estuary.—Prof. J. H. Orton 665
  The Anti-Chromatic Reflex.—Prof. H. Hartridge, F.R.S. 666
  Early Observation of Antibiotic Action.—C. N. Davies 666
tionalization of Mineral Rights. By Prof. L. Dudley tamp 667
e Royal Statistical Society : Industrial and Agricultural esearch Section 667
earch Work at the Millport Marine Laboratory . 668
an Plywood for Tea Chests 668
n Innes Horticultural Institution 669

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A STATE SCIENTIFIC SERVICE IN BRITAIN

IN recent weeks the general public has learnt a great deal more of the scale and importance of the contribution made by scientific men, in the Government service and outside it, to the war effort. In the developments leading to the atomic bomb, radar and numerous other fields, the significance of that contribution, both in peace and in war, is now far more widely appreciated, and Lord Hankey in his recent book, "Government Control in War" stressed the need for organizing more effectively something of a Scientific Civil Service. The White Paper under that title which has now appeared[1] deals with the reorganization and recruitment of that Service during the reconstruction period. It falls into three parts. The first part outlines the Government proposals for effecting the reorganization of the Scientific Civil Service. The second part deals with questions of recruitment to the scientific service during the reconstruction period, which were left undetermined in the White Paper dealing with the administrative, executive and clerical classes last November. The core of the present White Paper, however, is the annex containing the report of the Barlow Committee on Scientific Staff. This report, dated April 23, 1943, is appropriately considered first. In general, it may be said that it fully substantiates much of the criticism of the conditions of service of scientific men in Government departments which found expression in debates in the House of Lords and the House of Commons and elsewhere.

The Committee, over which Sir Alan Barlow presided, consisted of Sir Edward Appleton, Mr. W. F. Lutyens and Prof. E. K. Rideal, and was asked to consider in particular the comparison between the initial salaries of administrative and scientific entrants; the question whether the existing conditions of service for scientific workers provide adequate prospects for the average entrant; and whether sufficient facilities exist for free interchange of scientific personnel, and in particular research men, between the Government service on one hand, and the universities, industry and outside bodies in general on the other. Inquiries were confined in the main to the Defence Departments and the Department of Scientific and Industrial Research: the Committee did not regard the engineering or medical services as coming within its scope. The Committee, however, sets out what it regards as the essential principles which should be followed to secure a higher standard of recruitment into, and so raise the general level of, the scientific establishments of the Government service, and emphasizes that it is essential that its recommendations should be implemented at the earliest possible opportunity, without waiting for a fuller post-war inquiry. It will be recalled that the present terms of service of scientific staff derive from the recommendations of the Carpenter Committee which reported in 1930, and that although those recommendations were endorsed by the Royal Commission on the Civil Service, they were not brought fully into operation until 1936.

All the evidence before the Barlow Committee points to the main conclusion that the Government failed in peace-time to attract into, and retain in, its service a proper proportion of the best scientific workers produced by the universities of Britain. The fault seems, to the Barlow Committee, to lie partly in the standards of remuneration and the prospects of promotion offered, but at least as much in general conditions of service and the relations between Government research organizations and the scientific world outside. In general, for scientific workers of average ability, of whom any large scientific organization is bound to require a substantial number, Government employment offers prospects, up to a certain level, which compare not unfavourably with those offered in most universities and in industry for men of like ability, and at present the Committee has no special comments to offer on the pay and prospects of such workers. It is in regard to the man of more than usual ability that improvement is necessary, and the Committee is emphatically right when it lays down as a first essential that the scales and system of promotion of the scientific classes should ensure that the best scientific men should have equal prospects of pay and promotion with the best men in the administrative class at least up to the top of the grade of 'principal'. The Government's present proposals in this connexion, taken in comparison with those relating to the salaries and organization of the administrative class, are criticized by the Institution of Professional Civil Servants in a pamphlet entitled "A New Deal for Government Scientists ?"[1]; for the outstanding scientific man would still be well below the outstanding administrator in salary level, and neither the average nor the outstanding scientific officer has been given parity with administrative officers.

In devoting the major part of its report to this question of attracting to the service of the State a proper proportion of the ablest men of science coming from the universities, the Barlow Committee is clearly in harmony with general opinion in Britain as revealed in discussions on the organization of scientific and industrial research during the last two years. Dealing first with remuneration, the Committee points out that there has been some divergence of practice between departments in implementing the Carpenter Report, and it considers that departments should be prepared to offer initial salaries above the minimum of the junior scientific officer scale to candidates who have spent one or two years in postgraduate research. The existing provisions for recruitment direct into the grade of 'scientific officer' could also be utilized, and there should be regular recruitment to that grade at a later age by means of an examination similar to that applied by the 1851 Commissioners.

Evidence submitted to the Committee was unanimous as to the necessity of providing rapid advancement for outstanding men, and the Committee recommends that the existing authority to give special advances within the scale to a limited number of officers should be extended. The problem of securing rapid advancement beyond the grade of 'scientific officer' for the outstanding scientific work is primarily that of so regulating the proportion higher to lower posts as to ensure reasonable pro pects of promotion. The outstanding man shou be able to reach the grade of 'principal scientif officer' in the early thirties, and to this end tl Committee recommends full use of the Carpent Report recommendation under which such promotic should be made by reference to outstanding individu work, even if the research officer is lacking in capacit for organizing and directing the research work others. While the Treasury should be ready authorize special additional posts, in return tl Treasury might require that the nomination f any such post should be approved by the Inte Departmental Scientific Panel, establishment which is recommended to maintain a uniform stan ard for such special advancements and promotio and to improve administrative liaison between tl departments. Moreover, any step which assists tl heads of scientific departments to a fuller knowled of the work done in other departments would itself be of value.

Beyond this, in regard to remuneration, the Com mittee also recommends that the salaries of tl highest posts on the scientific side of the Governme service should be increased. This would also hav the effect of narrowing the gap between the pay such posts and that of the highest posts on tl administrative side ; but the Committee goes furth and urges consideration of the possibility of mo frequent transfers of suitable men of science to tl administrative class. Here it raises a fundament issue the importance of which has been widely reco nized already in comment on the White Paper. It not merely that the report challenges the whole id that the scientific worker as such is by training ar outlook inherently unfitted for high administrati office. When the Barlow Committee recommen that the provision of special machinery to ensu that scientific workers serving in departments wit out any administrative cadre of their own should considered for transfer to administrative vacancies other departments, it is not merely thinking of ope ing up wider avenues of promotion for men of scienc it has equally in mind the benefit to Governme business from the introduction of a different outloo particularly in departments where the work is co cerned with scientific and technical processes.

This broadening of the basis of recruitment to tl highest posts in the administrative class of the Ci Service is of the utmost importance to enable t Civil Service to become competent to deal with t affairs of the post-war world ; and it is to be hop that neither this point, nor the corollary of the fre admission of scientific men to posts where th exercise more and more influence over social planni and administration—that men of science themselv must be more adequately trained in the humanit and cultural subjects and early specialization avoid —will not be overlooked in the debate which is lik to ensue on the White Paper. It would indeed b tragedy if the Institution of Professional Ci Servants, which seems to have misconstrued co etely the Barlow Committee's concentration on the provement of the conditions for the outstanding an of science, failed to lend the weight of its support proposals of the highest significance from the ational point of view.

We can find in the Barlow Report no substantial undation for the suggestion, indignantly and rightly pudiated by the Institution, that existing scientific affs are inferior in quality to their colleagues outde the Government service. That is no valid deuction from the conclusion that the Government rvice in peace-time did not attract and retain a fficient proportion of the best men of science coming om the universities of Britain; and in the important ction of its report dealing with general conditions f service, the Committee's observations are pertinent the average as well as to the outstanding scientific ficer. Moreover, it recognizes clearly that there ould be the closest contact between research and velopment, and that a high standard of recruitent is as necessary on the development as on the search side. It makes indeed no firm recommendaon as to the continued distinction between the ientific and technical grades, but is of the opinion at the designation 'chemist' might be discontinued nd the present long salary scales for technical fficers and chemists divided into two.

One of the dangers to which a Government scientific ranch is inherently liable is the tendency towards olation from the rest of the scientific world. This detrimental both to their work and to recruitment, ad to overcome that tendency the Barlow Committee akes various suggestions. Extra-mural research ntacts are of great benefit, and heads of scientific epartments should try constantly to improve concts with both university authorities and students. emporary interchanges of staff with the universities, ecial leave with pay to attend scientific meetings ad conferences, as well as exchanges of staff with dustry, direct contact between Government scienfic branches, especially in administration, and ansfers of scientific staff from one department to nother are desirable; though research workers ould, wherever practicable, remain associated with rojects which they themselves have started. It oes not recommend, however, a unified State cientific Service with a single establishment and sponsible to a common head. Great importance is ttached to the introduction of a scheme on the nes of a 'sabbatical year', under which selected ientific staff would be allowed special leave to work a university or other institution in Great Britain abroad, and attention is directed to the desirability locating research establishments so far as possible ithin easy reach of a university or intellectual centre ad in close proximity to other establishments workg on kindred problems. Direct contact at all levels etween the staffs of different establishments should e made easy.

One of the greatest disadvantages of the Governent scientific service is the extreme emphasis upon crecy. This both makes it difficult or impossible r the Government worker to enter into discussion th similar workers outside, and also prevents his obtaining recognition in the scientific world of the value of his work. Such conditions are not only a formidable barrier to recruitment but also to scientific work itself, by hindering the fertilization or stimulation of new ideas; and it is satisfactory to note from the White Paper that the Government views sympathetically the recommendation that secrecy restrictions should be as much as possible relaxed, and scientific workers encouraged both to publish work of their own and to discuss their work with persons outside the service engaged on similar problems. Furthermore, the Government particularly approves the Barlow Committee's recommendations for dealing with this tendency to isolation, and proposes that one of the first tasks of the new Interdepartmental Scientific Panel should be to consider how they can be implemented.

With regard to secrecy, the Barlow Committee suggests as a solution that it should not be assumed as a matter of course in peace-time that the whole of the work of a research establishment must automatically be regarded as secret; matters of fundamental research should be regarded as *prima facie* suitable for discussion with outsiders, and the questions on which absolute secrecy is prescribed should be kept to the minimum. The head of a research establishment should have discretion, and be encouraged to allow his staff to discuss their work confidentially with members of outside institutions who are engaged on similar problems, and a system should be possible whereby members of the staff engaged on secret work could submit theses for higher degrees. Fuller use might be made of advisory councils to secure professional recognition of the work of Government scientific workers, and lectures by eminent men of science and 'colloquia' should be encouraged, and adequate lecture-rooms, libraries and workshops provided. Finally, the Committee points out that control of civilian scientific staffs by uniformed officers tends to be prejudicial. Uniformed officers should act as advisers on behalf of the user services rather than as direct controllers of research and development. Further, heads of laboratory units should have more freedom in procuring equipment.

No scientific worker will mistake the importance of the Barlow Committee's Report or the weight of the support it brings to policies and principles that have long been advocated in these columns. It is the more satisfactory to find that many of the recommendations of the report have been accepted by the Government and incorporated in the Government's proposals, which in some respects go beyond those of the Committee. Moreover, the White Paper points out that the investigation of these questions had begun under the Coalition Government, which was equally resolved on the reorganization of the scientific service; and it may therefore be hoped that consciousness of the contribution made by science towards winning the War, and of that which science can make during peace to the efficiency of production, to higher standards of living, to improved health and to the means of defence, is shared by all political parties.

The Government proposes to establish an Interdepartmental Scientific Panel, of which Sir Edward

Appleton will be chairman, with the further responsibility of keeping under review the well-being and efficiency of the Government scientific service. It will also make proposals for any desirable changes in the organization or conditions of service necessary to this end, in addition to that proposed by the Committee of maintaining a uniform standard for promotions and special advancements and improving administrative liaison between departments. In order that pension arrangements may not constitute a barrier to interchange of staff with the universities, almost all scientific officers in the permanent service of the Government will be brought under the Federated Superannuation Scheme for the Universities. The salaries of the most highly qualified members of the scientific service are to be brought into relationship with those of the administrative class, and at the recruitment stage they are to be aligned to them. Special provision will be made for recruiting, above the normal minimum salary, university graduates with research experience, and also for recruiting direct to grades above basic, scientific workers who possess special qualifications or experience which a department requires.

The Government has also accepted the recommendation that ultimate prospects should be improved, including provision for the promotion, above the level of 'principal scientific officer', of individual research workers of exceptional ability, without necessarily expecting them to carry administrative responsibility. Furthermore, the present class of 'assistant' is to be strengthened, re-named the 'experimental officer' class and more fully used, much of the work at present done by scientific officers being devolved on scientific assistants. There will be provision for promotion from this class to the scientific officer class under conditions which will be considered later by the Scientific Panel; but the Government also proposes a provincial differentiation in salary scales, to which the Institution of Professional Civil Servants has already objected and which may well be the subject of wider and reasoned criticism. It is proposed to recruit the whole of the scientific service centrally through the Civil Service Commission, and with this in mind Dr. C. P. Snow's name will be submitted for appointment as additional Commissioner with special responsibility during the reconstruction period for the recruitment of scientific and experimental officers.

This scheme of reorganization applies to staff employed directly by Government departments, but the adaptation of these arrangements to suit the needs of the staff employed by other institutions working under the ægis of the Medical Research Council, for example, the Agricultural and Fishery Departments and the Development Commission, is now under consideration. Finally, in the second part of the White Paper, there are set forth the lines on which it has been agreed with the national staff side of the Whitley Council that the general principles outlined last year in the White Paper "Recruitment to Established Posts in the Civil Service during the Reconstruction Period" can best be applied in the scientific field, and in accordance with which recruitment will be carried out. These conditions includ the restoration of open competitions for entry to th Scientific Civil Service as soon as possible, with specia reconstruction competitions over a period, publication of full particulars throughout the Forces, wit arrangements to ensure that any possible candidate serving in Europe or the Far East have an opportunity of being considered, and provision for retention in a permanent capacity of specially selecte senior temporary officers, above the maximum ag allowed in the open reconstruction competitions, wh possess exceptional ability or experience, as well a for retention in the basic grade of assistant experimental officer of a proportion of the best of the temporary officers, above the age of thirty, in the existin grades of Assistant II and Assistant III.

The Institution of Professional Civil Servants ha published, in the pamphlet already mentioned, a careful analysis of the new scales—those for the administrative class are outlined in a further White Pape published simultaneously—which shows that both fo scientific officers and experimental officers the ne careers should be a considerable improvement on th old. The outstanding scientific officer would have career roughly equivalent to that of the good averag administrator, but the average scientific officer woul compare unfavourably with his administrative colleague. Apart from the question of provincia differentiation introduced for scientific men for th first time, the Institution's main objection to the proposed scales is that the scheme still leaves the scientifi worker in a position inferior to that of his administrative or executive colleague. There are further detail in regard to superannuation and the application o the scales on which discussions are proceeding, bu the Institution clearly recognizes that there is fo the first time to be a real Government Scientifi Service, recruited centrally through the Civil Servic Commission, instead of a haphazardly recruited serie of departmental classes. Nevertheless, to meet th widely varying qualifications of scientific workers, th grading will have to be interpreted broadly, and th proposed Interdepartmental Scientific Panel mus approach its task in no niggardly spirit.

Whatever criticism may be advanced in matters o detail, there can be no doubt that the whole schem represents a definite advance in recognition of th value of the scientific worker, and it is clearly th outcome of much sympathetic thought, practic knowledge and experience. Moreover, in certai features, such as the provisions for superannuatio and a sabbatical year, publication of results and th like, which encourage mobility of staff and the inte change of thought, it may well make a contributio to the stimulation of scientific and industrial advanc far beyond the bounds of the Government servic Such features call for close and sympathetic study b industry as well as by the universities in order t realize the full effect of the recommendations of t Barlow Committee.

To recognize this is not to suggest that the ne proposals provide all that is required. They represe indeed substantial recognition of the fact that Government without an adequate staff of scienti workers is properly equipped to direct the affairs of a modern country pervaded by scientific technique, especially when the range of Government control over industry and economic life tends to grow. But they do not in themselves indicate that there is any real appreciation that the administrator himself, be he Civil servant or Minister, requires some appreciation of the scientific outlook, some basic understanding of science itself, if he is to handle competently issues of State into which scientific and technical factors ncreasingly enter.

To that extent scientific workers generally will be at one with the Institution of Professional Civil Servants in refusing to be content with any scheme which leaves the man of science in a position inferior o that of his administrative or executive colleague. The Barlow Committee has rightly stressed the mportance of attracting into the Government service a proper proportion of the ablest scientific workers produced by the universities of Britain. It is no less important, however, that the conditions of a scientific career, either within the Government service or without, should be such as to attract a fitting proportion of the ablest and most promising young minds among those who year by year enter the universities. That is the real reason for insisting on parity so far as possible between the administrative and scientific sides, and for reducing still further the difference in the prospects of the outstanding man who enters on an administrative as compared with a scientific career. If at the same time, as has been suggested, the general history of science and scientific method were made a compulsory examination subject for the higher Civil Service posts, and on their side scientific workers themselves saw to it that other cultural subjects were not neglected in the curriculum for a science degree, there is every reason to believe that under the Interdepartmental Scientific Panel the new proposals may provide the scientific worker in Government service not merely with improved conditions of remuneration, but also with a status and a freedom which will be a stimulus to creative effort and form the basis of an attractive and distinguished service.

The Scientific Civil Service Reorganization and Recruitment during the Reconstruction Period. (Cmd. 6679) Pp. 16. (London: H.M. Stationery Office, 1945.) 2d.
The Administrative Class of the Civil Service (Cmd. 6680.) Pp. 16. (London: H.M. Stationery Office, 1945.) 2d.
A New Deal for Government Scientists? Pp 12. (Institution of Professional Civil Servants, 17 Hans Place, London, S.W.1, 1945.) n.p.

ARISTOTLE'S CRITICISM OF PLATONISM

Aristotle's Criticism of Plato and the Academy
By Harold Cherniss. Vol. 1. Pp. xxvii+610. Baltimore, Md.: Johns Hopkins Press; London: Oxford University Press, 1944.) 33s. 6d. net.

MR. CHERNISS'S large volume will be most welcome to all serious students of Greek philosophy; none the less that it lays a heavy burden of duty upon them. There is already a vast literature in many languages dealing with the meaning and value of the criticisms of Plato by his most eminent pupil, and a wide discrepancy of opinion on almost every aspect of the problem. Often it is disputable whether a particular criticism is directed against Plato himself or against some Academic of the first generation, Speusippus, Xenocrates or another, and his version (or perversion) of the master's meaning. Where the *critique* is levelled against Plato by name, it is often uncertain what precise pronouncement of Plato is being attacked and what the precise point of the attack is meant to be. Even when Aristotle expressly quotes the words of a Platonic dialogue for controversial purposes, his quotations are often not quite accurate (presumably because the very format of a Greek book made 'verification of references' almost impossible). Even when the quotation is exact, we often see that its meaning has been twisted by Aristotle's habit of treating metaphorical language as though it were meant for a literal statement of matter of fact, or his tendency to assume that a word has in Plato the same precise sense as it bears in his own technical vocabulary. How, then, are we to deal with criticisms which, like most of those aimed in the "Metaphysics" at the "Theory of Ideas", are concerned with statements never expressly made in the Platonic dialogues at all? If Plato said these things, it must have been in what Aristotle calls his 'unpublished' teaching. How can we trust implicitly either Aristotle's apprehension of Plato's meaning, or even his accuracy in reporting Plato's words? Small wonder that there should be in the literature to which such a problem has given rise *quot homines, tot sententiæ.*

In the work of which the present large volume is the first half, Mr. Cherniss proposes to discuss this vast problem on a scale so far unprecedented, at least in the English language. He is in many ways well equipped for the task. His earlier volume on Aristotle's criticisms of the "Presocialists" revealed him as an excellent scholar, and he seems, moreover, to have made himself acquainted with almost everything which had been previously published on his present subject down to the present day in a way which can only awaken admiration and envy. Whether his own conclusions come in the end to be generally accepted or not—and I conceive that he himself would readily admit that on many points the last word has by no means been said—his book will remain an indispensable storehouse of learning and acute criticism from which future investigation will have to start, whether it ends by confirming his verdicts or not. Even those contemporary students whose views he is most concerned to overthrow will be sincerely thankful to him for his achievement, though they may not always feel themselves 'killed dead' by his great guns.

Properly speaking, it would be premature to attempt any 'review' of the book until Vol. 2 is before us. Only there does the writer intend to deal with the most difficult part of the whole subject, the alleged identification by Plato of his "Ideas" with *numbers* of some kind. In the present volume, he confines himself to acute examination of the strictures passed in the Aristotelian *corpus* on the 'ideal theory' in what Aristotle calls its 'original form' (except in so far as some of the appendixes are concerned more immediately with certain fundamental cosmological issues, particularly with the question whether Aristotle gives any support to the view that Plato at any time disputed either the motionlessness of the earth or its central position in the universe).

In this position of affairs, it seems almost imperative to suspend one's judgment of Mr. Cherniss's work until its publication is complete. From the present instalment, indeed, one may make a wide guess at what is to come, but only a *wide* guess. It is clear that, as is only natural, the writer attaches very great weight to the views of his eminent American predecessor as a Platonic scholar, the late Prof. Paul Shorey, on the life-long 'unity of Plato's thought'. I hope, however, that when he comes to discuss the so-called 'Idea-Numbers', he will handle the theme with less contemptuous impatience than Shorey, who brushes the whole subject aside as a mass of "clotted nonsense". The influence of Shorey's well-known "Unity of Plato's Thought", which is so manifest in the present volume, seems to me to be in the main beneficial. But I sincerely trust that in the sequel yet to come the unity will not be exaggerated, as I think it was by Shorey himself, into something like monotony. A great philosopher can be consistent through a lifetime without merely repeating himself endlessly.

If I occasionally find Shorey's influence unduly strong in certain places in the present volume, it is rather in some of the appendixes than in the main text. Mr. Cherniss is manifestly very anxious to convince himself that, as Shorey also held, Plato adheres from first to last to a cosmology with a stationary earth at the centre of the universe. Now it is certainly possible to make out a case for this view, a case which requires serious consideration, and Mr. Cherniss is fully entitled to do so. But there is also a case for disputing it. *Prima facie*, for example, the "Timæus" appears to ascribe motion of some kind to the earth, and Aristotle says in explicit words that the "Timæus" does this. It is undeniable that Theophrastus somewhere made a statement that appears to represent the aged Plato as having recanted his earlier belief in the earth's central position. This evidence has to be fairly and squarely met, and Mr. Cherniss sets himself to meet it. But I doubt whether he himself would claim that he has done so very convincingly. He argues ingeniously enough that in the passage of the "de Caelo" which has always been understood to assert that the "Timæus" teaches the mobility of the earth, Aristotle is only reporting an interpretation of that dialogue by certain unnamed Academics, which he himself regards as a misinterpretation. The evidence about a change in Plato's view as to the central position of the earth is disposed of by the suggestion that Plutarch, on whom we depend for our knowledge of what Theophrastus said, has misunderstood his author. All this, to be sure, is not impossible, but it is another question whether a judge who came to the consideration of the evidence with a mind not already as good as made up would find it very probable. (To me, I own, it seems a case of 'special pleading', but I too, of course, have my own initial bias.) I admit, indeed, that against those who have tried to find 'Copernicanism' in Plato Mr. Cherniss proves his case once for all.

I trust I have said enough to make it clear that though Mr. Cherniss's work cannot properly be reviewed to much purpose until it is completed, it is one of capital importance and will be indispensable in future to all serious students of Plato; and, indeed, of Greek philosophy generally. Unfortunately, the use which such students can at present make of Vol. 1 is seriously hampered by the absence of an index. This will, no doubt, be supplied in Vol. 2, and one hopes on the generous scale which such a book deserves.

A. E. TAYLOR.

ADVANCED MATHEMATICS

(1) Théorie des fonctions

Par Prof. Georges Valiron. (Cours d'analyse math matique, 1.) Pp. vi+522. (Paris: Masson et Ci 1942.) n.p.

(2) Les coniques

Par Prof. Henri Lebesgue. Pp. vii+190. (Pari Libr. Gauthier-Villars, 1942.) 150 francs.

THE two books under notice, published whi communications between France and Englan were cut off, have only recently reached Great Britai

(1) This, the first part of the latest course mathematical analysis, is an excellent book. In volume of 522 pages the author deals thorough with functions of both real and complex variable After proving a standard theorem, he usually appli it to an example of great intrinsic importance, ofte one prominent in recent research. This gives delightful freshness to the treatment. By the aid numerous historical notes, the reader learns how a idea first arose, and how it developed. For exampl in explaining the idea of an integral, we have reference to the early work of Cauchy and Lejeun Dirichlet, a full account of that of Riemann, a litt on that of Stieltjes, and then a whole chapter on th Lebesgue integral. Finally, we are shown the necessity of a further generalization, such as that due t Denjoy, and told where it can be studied.

To make room for the considerable amount matter not usually found in such courses, the autho has omitted elementary work likely to be well know to his readers, and has used rather small prin Unlike many recent English writers, he has include a chapter on elliptic functions. There are also sections on vector analysis, Riemann's zeta functio numerical integration, and many other subjec which, although there is no index, can be traced fro a very full table of contents. The second volume wi deal with functional equations.

(2) The name of Lebesgue is so well known in connexion with his theory of integration that we may b unaware that his primary interest was in geometr At various times he wrote several papers on conic Shortly before his death, he collected ten of thes together to form the five chapters of the present boo He intended to write an introduction to each chapte but was not able to complete more than the first tw

It is said that Prof. Lebesgue never read a mathematical paper through to the end, but always turne away to develop the subject on his own lines. H wished the readers of his own book to do likewis and to work out for themselves any of the numerou stimulating suggestions that he provided. This make it comparatively unimportant that the author w unable to give a final revision to his work, and impart greater unity to its somewhat miscellaneou contents. The first chapter gives suggestions f replacing the usual treatment of conics by ne methods, chiefly concerned with homographic tran formations of the plane. The second and third de with focal lines and focal circles. The fourth chapt is devoted to Poncelet's polygons, making conside able use of the work of Cayley and Sylvester. The fif chapter is an unusual treatment of diameters of pla algebraic curves, using the theory of finite groups.

The colloquial and sometimes ironical style of so of the pages may surprise the reader, but, accordi to the preface by his friend, M. Paul Montel, the recall the author's characteristic and attract lectures.

H. T. H. PIAGGIO.

A PHYSICAL THEORY OF THE SOLAR CORONA

URING the recent visit of several distinguished Indian men of science to Great Britain, the Phy- ical Society prevailed upon some of their number o deliver addresses to English audiences on subjects f their own choosing. On November 23, 1944, Prof. L N. Saha described to a crowded audience in the ooms of the Royal Society his theory of excitation n the solar corona. An abridged account of the ecture and the discussion which followed it has lready appeared[1], and the full text is now published y the Physical Society[2].

Prof. Saha believes that many outstanding phe- omena observed on the sun, such as prominences, pots and chromospheric flares, can best be explained y assuming that nuclear reactions take place all ver the solar surface, and especially vigorously in ertain limited parts. Nuclear processes in the deep nterior were first invoked some years ago to account or the sun's energy generation; but Saha now sug- ests that similar reactions occur on a reduced scale t or near the surface. He bases his opinion on two ets of facts, both of which, he believes, point to this onclusion. First, the occurrence of He I and He II ines in the spectrum of the chromosphere is com- letely inexplicable on present theories. The ordinary hermal ionization theory (itself Saha's work) is uccessful enough in explaining ordinary Fraunhofer ines of excitation potential of order 5 eV., but fails o account for such lines as He II 4686 A., a prominent ow-level line of excitation nearly 75 eV. observed in he flash spectrum. Secondly, Edlén's brilliant dentification[3] of the coronium lines, which calls for he existence in the outer atmosphere of the sun of on atoms which have lost 9–13 electrons, nickel toms which have lost 11–15 electrons, and calcium toms which have lost 11–12 electrons, requires a oronal excitation of the order of 500 eV., and vidently necessitates drastic revision of our ideas f solar physics. Saha provides this revision and claims o resolve both difficulties simultaneously in his new heory.

No particular nuclear reaction need be postulated o account for the helium super-excitation in the hromosphere: any one of the many nuclear pro- esses producing α-particles is sufficient. These articles (which are, of course, unobservable on the un) are supposed by Saha to be shot out at high peed from some sub-surface reaction, and projected hrough the reversing layer and chromosphere. There hey will ionize solar atoms along their path by ollision, losing energy the while until each can retain captured electron, so forming ionized helium, and ventually another to give neutral helium. Those articles which capture electrons in excited states ill be in a condition to emit the spectra of He II nd He I respectively, which will thus be expected s indeed they are observed) in the low and high hromosphere respectively. The presence of the line D_3 (He I, 5876 A.) in absorption above disturbed reas of the solar surface suggests the presence of a emporary helium-rich atmosphere above spots which ay result from these nuclear reactions.

A more specific mechanism is postulated by Saha account for the super-excitation in the corona. He supposes that in the reversing layer, below the ase of the chromosphere, a nuclear process takes lace which is identical with or closely akin to that of uranium fission. The products are high-energy stripped atoms which are shot through the solar atmosphere, ionizing solar atoms by collision in its lower parts, and capturing electrons and emitting X-rays and forbidden coronal radiation farther out.

Among the debris produced by their passage are electrons—δ-rays which are knocked forward and escape, to constitute the electron atmosphere which we know as the outer corona. The reaction produced in the laboratory by neutron bombardment of uranium or thorium is of the type

$${}_{92}U^{235} + {}_0n^1 = xA^{M_1} + yB^{M_2} + Z_0n^1 + Q,$$

where A and B are new nuclei of masses M_1 and M_2 and charges x and y; Z is the number of neutrons (usually three or four) evaporated: and Q ($\sim$ 200 MeV.) is the energy released. In binary fission of this type, A and B are usually unstable and pass by a chain of β-ray emissions to stable end-products. The energy Q is distributed between these according to the law of conservation of momentum; and the important point is that it is so high that the fission particles separate with velocities much larger than the orbital velocities not only of their outer electrons but also of many of those in the inner shells. As a result, the fragments start their independent career highly ionized and moving at speeds of the order of the orbital speeds of electrons in the inner orbits of atoms. Saha shows that if the initial process is a ternary or quaternary fission, the fragments, after stabilization through β-emission, are likely to be atoms from calcium to nickel emitted with a kinetic energy of about 60 MeV. For an iron atom this means that the outer 15 electrons cannot be retained, and the fragment starts out with the ground structure $1s^2 2s^2 2p^6 3s$. Saha calculates the range of particles of this kind in a solar atmosphere of plausible constitution, and decides that only such fissions as occur at or above the reversing layer can contribute to the coronal radiation: those which occur deeper in the sun give particles which are stopped by collision before they penetrate the chromosphere.

The subsequent history of the stripped atoms is as follows. The Fe^{+15} ion (itself spectroscopically unobservable) loses energy by collision with solar atoms along its trajectory and eventually captures an electron, bound or free, to become Fe^{+14} in an excited ($3s\,nx$) or normal ($3s^2$) state. In the former case it emits the extreme ultra-violet spectrum of Fe XV before reaching the ground-state. There are no metastable levels, so no visible radiation is to be expected. Then the process of electron capture is repeated and the Fe^{+13} ion is formed. Allowed transitions here can again give rise only to radiation of extremely short wave-length, but this time the ground-state is an inverted doublet, and the forbidden transition ${}^2P_{1/2} - {}^2P_{3/2}$ results in the emission of the famous green coronal line of Fe XIV. Successive electron captures gradually build up the next electron shell, and the spectra Fe XIII . . . Fe IX are emitted. Most of these contain forbidden lines in the accessible region, and most of the observable lines in the corona are attributed by Edlén to such of these ions as have metastable ground-levels, or to their isoelectronic analogues in nickel or somewhat similar calcium ions.

The theory thus depends upon the occurrence of ternary, quaternary or possibly unsymmetrical binary fissions in uranium or thorium near the sun's surface. Uranium has not yet been detected spectroscopically in the reversing layer; but faint lines attributed to ionized thorium have recently[4] been discovered in the Fraunhofer spectrum. Presumably no great abundance of fission nuclei is necessary, since the coronal radiation is, after all, very weak relative to the thermal radiation of the whole sun; it can be observed only during total eclipses or by taking extraordinary precautions against extraneous light at other times. A more difficult point concerns the apparent selection of iron, nickel and calcium as fission products. Why should no lines of, say, highly ionized cobalt, manganese, copper or potassium appear? This is partly a spectroscopic matter: the elements found are better suited for identification than all the others except cobalt, and here, as elsewhere, absence of the spectrum of an element is no guarantee of the absence of the element. A faint coronal line at 4359 A. is indeed attributed to Co XV. But there is no denying that the iron, nickel and calcium lines represent most of the coronal emission, and the contiguous elements, even if they turn out to be represented among the fainter lines, are likely to be relatively rare. Saha attributes this to the greater probability that fissions will result in even atomic numbers than in odd, the former having many more stable isotopes than the latter. This leaves some doubt concerning chromium and titanium (especially the former, which has predicted forbidden lines in the accessible region), and an alternative explanation put forward by Edlén in his original paper[5] deserves consideration. He noted there that the observed lines belong to elements common in meteorites, the implication being that coronal matter is not directly of solar origin at all, but is a cloud of meteoritic gas collapsing on to the solar surface. Saha will have none of this on energetic grounds, however, and points out that the velocities involved (622 km./sec. from infinity to the solar surface, less to the corona) are not sufficient to produce the observed ionization.

The fate of Saha's stripped atoms, once they have emitted the coronal lines, is doubtful, for it depends on the ranges of the various particles in a part of the solar atmosphere where the composition is as yet rather uncertain. It might be supposed that the process of electron capture outlined above would go on as the ion continued its progress through the corona, and that accordingly lines due to Fe VIII, Fe VII . . . Fe I and the corresponding nickel and calcium lines should be emitted at greater heights. But between Fe VIII and Fe III the capture is in *d*-orbits, where the capture cross-section is small, so that even where other conditions (for example, presence of deep metastable levels with accessible transitions) are favourable, the lines will be expected to be faint. In fact, the probability of electron capture may be so small that these less highly ionized particles may escape into regions devoid of hydrogen atoms or electrons before they can make further captures. The lower ions will in that event play no part in coronal emission, though they may become of interest to geophysicists!

The value of the new theory, if it can be supported at the many points where observational verification is possible, lies not only in the explanation it affords for the observed high excitation in the inner part of the corona, but also in the light it throws on the spectrum of, and intensity distribution in, its outer parts. That it suggests that the outer corona is not in equilibrium but consists of outward streaming δ-rays continually ejected from solar atoms by fission fragments is an advantage; for questions concerning the origin, maintenance and stability of the out corona have hitherto been embarrassments to tho who held it to be an atmosphere in equilibriu Saha's conception of the chromosphere and inn corona as a sort of gigantic cloud chamber, whe the tracks of individual particles are invisible b where the particles are so abundant that their recombination spectra are observable, is more than picturesque illustration. It removes the difficulty accounting for the extremely high 'temperatur needed to produce the coronal lines. It was alwa incredible that temperatures of millions of degre could exist in parts of the solar atmosphere where black sphere would be expected to reach at mo 4,500° C. It is now clear, if Saha is right, that th phenomenon is quite local, and is comparable wit the local luminescence produced in our own atm sphere by meteors. (Perhaps a better comparison, view of the direction of motion of the particles, with terrestrial rockets.)

Many points remain to be cleared up, of cours and much experimental and theoretical work mu be done before the theory can be regarded as mo than tentative. But as a first attempt to accou for the extraordinary features of the solar coro brought to light by the identification of the emissio lines in its spectrum, this theory merits and w receive astrophysicists' serious consideration.

A. HUNTER.

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[1] *The Observatory*, 66, 18 (1945).

[2] Saha, M. N., *Proc. Phys. Soc.*, 57, 271 (1945).

[3] Hunter, A., *Nature*, 150, 756 (1942).

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[5] Edlén, B., *Ark. Mat. Ast. Fys.*, 28B, No. 1 (1942).

THE CITY AND GUILDS COLLEG

ENGINEERING AT THE IMPERIAL COLLEGE

By PROF. E. F. D. WITCHELL

THE City and Guilds College forms the engineerin section of the Imperial College of Science an Technology, the centenary of which was recentl celebrated (see *Nature*, Nov. 3, p. 518 *et seq.*). As i name implies, the City and Guilds College itself ow its existence to the City Livery companies, who m at the Mansion House on July 3, 1876, under th presidency of the then Lord Mayor and decided t devote attention "to the promotion of educatio throughout the country and especially to technic education". As a result of this meeting, the Cit and Guilds of London Institute for the Advanceme of Technical Education was established in 1878 an was incorporated in 1880. The provisional committe of the Institute recommended "that the objec which the Guilds had in view would be best attaine firstly, by the establishment of a Central Institutio or College for the advanced education of those wh had already acquired sufficient knowledge of scien or the arts to profit by instruction in the industri application of these; secondly, by conducting exan inations in technological subjects; and, thirdly, b the establishment of local schools for artisans an workmen, and by co-operating with and otherwi assisting local effort, more especially, but not e clusively, within the Metropolis".

The first of these recommendations led to t establishment of the College in Exhibition Road. T foundation stone of the building was laid in 1881 the Prince of Wales, who opened the new building three years later.

The College was known as the Central Institution, nd its declared objects were "to afford practical, scientific and artistic instruction which shall qualify persons to become: (I) technical teachers; (II) mechanical, civil and electrical engineers, architects, builders and decorative artists; (III) principals, superintendents and managers of chemical and other manufacturing works.

"The main purpose of the instruction to be given in this Institution will be to point out the application of the different branches of science to various manufacturing industries, and opportunities will be afforded or the prosecution of original research with the object of the more thorough training of the students and for the elucidation of the theory of industrial processes."

It was proposed to carry out these objects by instituting five departments, namely: (1) Chemical Technology; (2) Engineering; mechanical, civil and electrical; (3) General Manufactures; (4) Architecture and Building Construction; and (5) Applied Art.

Students were required to pass an entrance examination in mathematics, pure and applied; chemistry; physics; drawing and modern languages. The courses in all departments were to be of three years duration, and the diploma of the College (A.C.G.I.) was to be awarded to those who had studied satisfactorily during the course and passed the various examinations with credit.

Three professors were appointed in April 1884, namely: Henry Edward Armstrong, as professor of hemistry; William Cawthorne Unwin, professor of ngineering; and Olaus Henrici, professor of mechanics and mathematics. Later in the year, William Edward Ayrton was appointed professor of physics. These four professors were charged with devising the schemes of education which should be adopted for training students following diploma and special ourses in the various departments. The general scheme proposed for diploma students provided that the first-year course should be a common course for ll students no matter in which department the student wished to graduate. The subjects studied were mathematics, chemistry, physics, engineering drawing and engineering workshop practice. In the second year a small amount of divergence from the common course was permitted, especially for students in chemistry; but for engineering students almost all the course in electrical, civil and mechanical engineering was substantially the same. In the third year the student spent the whole time in the department f his choice, with the exception that during the winter term one day per week had to be devoted to study in another department. Mathematics was studied by all students throughout the three years f the course.

It will be seen that the scheme recognized the nportance of making a fairly wide training in general and applied science the basis for a satisfactory course in technological studies, and it deliberately discouraged too early specialization in any one branch of learning.

Evidence that the course as devised was sound in principle is provided by the fact that the alterations in the scheme during the last sixty years have been comparatively few. Perhaps even more convincing the testimony of past students, who affirm how useful in their professional careers they have found the general training received in the College.

The original proposals of the City and Guilds of London Institute envisaged giving instruction in general manufactures, architecture and building and applied art, as well as in chemistry, technology and engineering. A School of Art Wood Carving was instituted and lectures were given in architectural and allied subjects; but it soon became evident that the College buildings, although judged to be large and capacious by the standard of those days, could not adequately house classes in all the intended subjects. In 1887 Prof. Ayrton estimated that the new College was providing for little more than half the work for which it was originally intended, and only two years later Prof. Unwin reported that experience indicated that the resources of the Institution, both as to staff and apparatus, would be considerably taxed by the two hundred students for which the building was designed.

In 1893 the name of the College was changed from the "Central Institution" to the "Central Technical College". Under this name the College continued to function until it became part of the Imperial College in 1910, when it was renamed the "City and Guilds (Engineering) College", and eventually the "City and Guilds College". The style under which it was known during the first twenty-five years of its existence is still retained in "Old Centralians", the name of the Association of past students of the College.

By 1893 the number of students following the courses in engineering and chemistry exceeded two hundred, and it seemed obvious that the whole of the accommodation in the College would be required for the proper teaching of these subjects. In 1897 the School of Art Wood Carving was transferred to the Imperial Institute, and the rooms which it had occupied were used for a laboratory for mathematics and mechanics. The basement of the Royal School of Art Needlework, which was built in 1901 on the site immediately south of the College, afforded much-needed accommodation for the Electrical Machines Laboratories, which had previously been inadequately housed; and the transference of the Electrical Laboratories in turn enabled an extension of the Civil and Mechanical Engineering Laboratories.

In 1900 the 'internal' side of the University of London was established and the College became a School of the University in the Faculty of Engineering.

The chief event in the College history since that date has been its incorporation with the Royal College of Science and the Royal School of Mines to form the Imperial College of Science and Technology. The immediate effects of the amalgamation occurred in 1913, and were the closing of the Chemical Department, the fusion of the Mathematical Departments of all three Colleges into one department, and the division of the Civil and Mechanical Engineering Department into Departments of Mechanical Engineering and Civil Engineering. Further facilities for research were provided, and the size of the College was approximately doubled by the building of engineering workshops in the rear of the building and the erection of the Goldsmiths Extension on the land immediately to the north of the original building. Most of the design of the general lay-out of these extensive laboratories is due to Prof. W. E. Dalby, who had succeeded Prof. Unwin as University professor of engineering in 1904. The foundation stone of the Goldsmiths Extension was laid in 1909 by King Edward VII and the building was finished in 1914. Owing to the War, the official opening of the building was postponed until 1926, when the ceremony was performed by the present King, then Duke of York. A much later addition to the College was the transference of the Aeronautical Department from the Royal College of Science, and still more recently the formation of a Department in Chemical Engineering.

The increase in the number of students has more than kept pace with the increase in accommodation. As mentioned above, the College was originally designed to accommodate two hundred students. This figure was exceeded in 1893 and kept steadily rising until, in 1911, it reached a total of 589 registered students, of whom 430 were working full time.

From the beginning, the teaching given in the College was fashioned on an experimental approach to knowledge rather than on precept. Lecture courses were, of course, given in all the subjects selected for study, but in all departments the importance of experimental work performed by the student was emphasized and the need for accuracy in such work was stressed. This point is well illustrated by extracts from the programme of the Central Institution for the session 1892–93. In the course of instruction in the Department of Mechanics and Mathematics, we read: "In the laboratory the experiments are performed by the students themselves. The experiments are all quantitative; that is to say, in each experiment the student has to make some definite measurement . . ."

Again, it is stated of the Department of Physics and Electrical Engineering: "The instruction is given largely by tuition in the laboratories, the lectures being rather for the purpose of aiding the students in their laboratory practice than of forming a distinct course by themselves". In the Chemical Department the object of the general first-year course is thus described: "The object aimed at in this part of the course will be to encourage habits of accuracy and thoughtfulness and to teach the art of experimenting with a logical purpose rather than to impress mere facts".

In the experimental sciences instruction by inquiry and experiment must always be slower than that given by lectures, but there can be little doubt which method is the better from an educational point of view. Training in careful habits of thought and logical deduction is an important part of any system of education, and the student is more likely to learn these by the success or failure of his own experimental work than by listening to lectures, however clear or eloquent they may be.

Experimental work also teaches the student that accuracy in observation and performance is needful for success. He learns the degree of accuracy which can reasonably be expected in such work and, what is perhaps quite as important, the limit of that accuracy. For this reason laboratory work has always occupied an important place in the College curriculum, and there has been insistence upon the writing of careful and complete records of the work.

It is difficult to assess the influence which the College has exerted on the practice and profession of engineering. It would, however, be easy to compile an impressive list of past students who have taken and are taking a leading part in the profession both in Great Britain and abroad, and who acknowledge the benefit to themselves of the training they received. They are to be found in all branches of engineering, administrative, executive, commercial and professional. Most graduates naturally practice in that part of the profession in which they were trained, but many who were trained in one branch now occupy responsible positions in some other branch. Thus men trained in mechanical engineering are to be found as wireless broadcasting engineers, electrical graduates are in charge of mechanical plant and so forth. The facility with which th men pass from one branch of engineering to another and seem to acquit themselves worthily in each, is tribute to the soundness of the College tradition o insisting on a training in general engineering befor allowing specialization in any one branch.

It must be remembered that, when the Colleg was founded, technical education was only just beginning, and the students passing from the College in the early days had the responsibility of proving to the profession that technical training was really worth while; to-day the need for such training i taken for granted and every town of reasonable size has some sort of technical institute. Even thirty-five years ago the students often found it wise when seeking employment with an engineering firm to conceal the fact that they were university graduates now, a degree is becoming a *sine qua non* for employment.

It would be extravagant to claim that the College is responsible for this change in the general outlook in Britain of the engineering profession, but it can be justly claimed that it has contributed largely to this more satisfactory state of affairs.

THE UNITY OF SCIENCE

On October 20 a meeting of the Association of Scientific Workers was held at Gas Industry House, S.W.1, "to explore the inter-relations between the natural and social sciences". The chair was taken by Sir Robert Watson-Watt, and the chief speakers were Prof. J. D. Bernal, Mrs. J. Robinson and Mr. Dennis Chapman. In his opening remarks, the chairman explained that the meeting had been convened to examine the implications of the increasingly closer relations which were growing between workers in the natural and social fields of science He therefore stressed the indivisibility of science in furthering what he called the "engineering efficiency" of the community. He announced that the Lord President of the Council, the President of the Board of Trade, and the Minister of Supply and Aircraft Production had been invited to attend the meeting, and all three Ministers had expressed their keen interest in the matter under consideration. The Lord President had replied that he would consider sympathetically any proposals formulated at the meeting which would be conveyed to him; the Minister of Supply and Aircraft Production was represented at the meeting by one of his directors of scientific research.

Prof. J. D. Bernal distinguished two aspects of the principle of the indivisibility of science. The phrase might be used in the philosophical sense of the unity of all knowledge, or in the highly practical sense of employing all the resources of scientific method regardless of the material to which it was applied. By establishing this principle in the practical sense, the artificial barriers hitherto separating 'natural' and 'social' scientists would be broken down. Prof. Bernal remarked that the demarcation between the natural and social sciences was of relatively recent origin; in seventeenth-century England, when odern science began to flourish, this line of distinc- on was not drawn, and indeed, some of the most ninent of the early fellows of the Royal Society ere those who had distinguished themselves in what ould now be called the social sciences.

He went on to say that there had for long been a istinction between the observational and the perimental sciences; but this was breaking down as direct result of the growing use of statistical method. tatistical methodology had come to mean designing periments in any field in such a way as to yield the aximum information, and not merely providing ays of analysing data. The natural and social iences were being brought together in a twofold anner: first, by a common statistical technique; cond, by a common area of operation. The inte- ration of the problems and methods of the natural nd social sciences was well illustrated by the war- me need to ascertain the effects of air-raids on roduction. Here the task was not merely to discover e number and physical effects of bombs but also assess the dislocation to the life of an industrial ommunity, and this involved the study of human ehaviour, including its economic aspects.

We were now experiencing a transition to a con- rolled and consciously integrated human life. Hence he great need for social experiments, designed to rovide the information whereby their outcome ould be evaluated with precision. Prof. Bernal elieved also that we were witnessing a revolution the methods of government, and this had a direct earing on the use of science. The problems of a com- unity that the man of science might be called upon o solve were as much 'social' as 'natural'. The object f the meeting was to facilitate in practice, as well as theory, the integration of the two groups of sciences. One of Prof. Bernal's specific proposals was that the ssociation of Scientific Workers should consider imulating broad surveys of the national economy in lation to its transformation from war to peace.

Mrs. Robinson, speaking as an economist, gave a arning to those who expect to get definitive and onclusive answers to economic questions. Problems f economics and allied studies were, she thought, ecessarily 'grubby' as compared with the neat and lear-cut problems of physical science. Hence it was uitless to pursue a perfectionist aim. Moreover, ectional economic problems could not be solved in olation from the economic setting of the community a whole. It was of no use declaring, for example, at a machine would work more efficiently if it were ade of diamonds. Schemes had to be formulated nder the restriction of their possible application in dustry. Mrs. Robinson said that a start had been ade in merging the efforts of various scientific orkers in studying coal production, housing and wn-planning. As illustrative problems which might attacked by composite working parties, she men- oned: (1) the analysis of accumulated medical atistics; (2) the interaction between health and nditions of living; (3) economic aspects of bac- riological control of milk; and (4) output per man ur in industry; why, for example, was industrial ficiency in the United States, as judged by output r man hour, reckoned to be twice that of the United ngdom?

Mr. D. Chapman deplored the loose way in which itish sociologists were organized. The Institute Sociology was, he thought, out of touch with alistic work in the field, and sociology in the uni- rsities tended to be associated with the arts or with social philosophy rather than with science. Sociology at the London School of Economics was, by virtue of its location, he thought, unduly dissociated from scientific work in other parts of the University of London. Sociological research was very costly, and in the absence of adequate funds, sociological inquiries in England had inevitably been descriptive, and qualitative rather than quantitative. In his view this tended to make them trivial in character. The strongest branches of the social sciences were educational, industrial and social psychology, where there was a tradition of experimental method.

He made it clear that a very great deal of administrative action had its scientific aspects, and there should thus be scientific study of the problems at issue. Thus there was a marked contrast between the success of the Directorate of Selection of Personnel at the War Office, due to the application of scientific method to selection, and the primitive methods employed by the Ministry of Labour in dealing with comparable problems. Mr. Chapman deprecated the limitation under which the War-time Social Survey had had to operate, being wholly engaged on problems, sometimes of a trivial nature, referred to it from outside. He directed attention to the fact that Government Departments like the Ministry of Works and the Ministry of Town and Country Planning had appointed scientific advisory bodies which did not include social scientists. Other departments, like the Ministry of Health, did not employ social scientists though there were many problems which could be adequately dealt with only by persons with training in that field. Finally, he suggested that some co-ordinating body should be set up as a Social Science Research Council.

In the discussion which followed, a wide range of problems came to light, the solution of which depended on the joint efforts of workers in both the natural and social sciences. Several instances were cited from the work of the Ministry of Fuel and Power. The future of the coal industry was threatened not only by a reduction in manpower but also by the inefficient utilization of coal. The efficiency of plant using coal probably turned as much on the care used by the plant operator as on any other factor. Yet little was known about ways of bringing about an increase in the care given by operatives. No serious study had been made of the causes of the success or failure or indifferent results of various bonus schemes. In this problem technical, social, and economic factors were closely interwoven. Similar considerations applied to the study of the optimal retail price of coal of different grades of quality from the point of view of fuel economy. Thus, the method of applying flat-rate increments was a strong financial inducement to use good quality coal that was in short supply.

As an illustration from a different field, attention was directed to the apparent conflict between the needs of health on one hand, and taste on the other, in controlling the quality of milk by inoculating dairy herds against tubercular infection. There was danger in over-emphasizing one aspect at the expense of the other. In this connexion a special plea was made for integrating sociological and psychological considerations in scientific planning, and for encouraging the social scientist to study the relative importance of economic, æsthetic, health and other values in various contexts. Furthermore, the problem of how to change values and inducements was, it was suggested, a legitimate subject for scientific study.

Many other problems were suggested for investigation by 'working parties' composed of men of science with diverse training. Various speakers made suggestions for increasing the effectiveness of working parties. One suggested the inclusion of a trade unionist; another suggested including an administrator. The Association of Scientific Workers had already set up one working party to study problems of fuel and power. Yet another suggestion was to the effect that a working party be appointed to investigate the factors which prevented the community as a whole from reaping the benefits of scientific effort; this was described by one speaker as an investigation into 'social pathology'.

A good deal of the discussion was devoted to the possibility of extending into civil life the kind of 'operational' research that had been so successful in the Services and supply departments. In the Air Ministry, for example, an 'operational' research team working with Telecommunications Research Establishment had been assigned the task of introducing radar devices at R.A.F. stations. In time the team grew into an advisory body which was consulted on a very wide range of tactical and strategical problems arising out of the use of operational equipment. Most of the crucial problems could only be studied adequately by the closest co-operation between workers with very diverse training, background and interests. The work required close and constant contact with executive officers of the R.A.F.

As regards securing Government sanction for the application of scientific discoveries, comment was made on the 'vertical' structure of British government administration, and the consequent difficulties in getting inter-departmental co-ordination to operate schemes of the TVA type.

Several speakers referred to the resistance encountered, at different political and administrative levels, to the application of science to the problems of the civilian community. In the Services, once the policy had been adopted, the hierarchical structure could be used to ensure the introduction of new techniques in a way which was scarcely to be hoped for in private industry.

It was unanimously agreed to set up a Joint Sciences Committee to consider the proposals formulated at the meeting.

EFFECTIVE AND INEFFECTIVE STRAINS OF LEGUME NODULE BACTERIA

By DR. H. G. THORNTON, F.R.S.
Soil Microbiology Department, Rothamsted Experimental Station, Harpenden, Herts

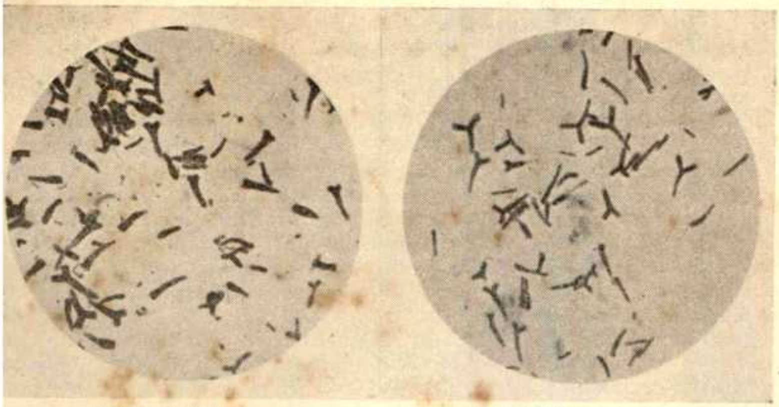
PROF. A. I. VIRTANEN, in a recent article in *Nature*[1], gave a brief summary of the work carried out in his laboratory on legume nodule bacteria. We await with interest the publication of these results in detailed form. It is already clear, however, that some of our investigations at Rothamsted have been on lines parallel to his, and that our results are complementary to some that he describes. A summary of our work where it touches on that at Helsinki may therefore be of interest.

Nature of the Ineffective Response

In observations on the structure of nodules produced by effective and ineffective nodules, Chen and Thornton[2] found that in ineffective nodules the h cells filled with bacteria were far fewer in numl than in effective nodules, and also that these ce and their contained bacteria disintegrated after period of active life which was but a small fracti of that possessed by those in effective nodules. the strains compared, the differences in volume a duration of this central 'bacterial' tissue were fou to account quantitatively for the difference nitrogen fixation, in that the quantity fixed per u volume of bacterial tissue in unit time was simi for the effective and ineffective strains. This res was obtained with strains both of clover and bean *Rhizobium*.

The transient nature of the 'bacterial tissue' ineffective nodules may explain two observati recorded by Virtanen in his article. First, the abse of red coloration in ineffective nodules may thus explained. Quantitative data are needed to relate amount of pigment with the degree of effectivene but we have examined nodules produced by seve hundred strains covering the whole range of effecti ness, and we confirm the observation that red col is rarely detectable in the centres of very ineffect nodules. But the red pigment is formed in the cent 'bacterial tissue,' so that the very short time dur which this tissue persists in ineffective nodules n well be insufficient to enable a visible amount of pigment to accumulate in them. Thus the abse of visible pigment may be the result of the ch acteristic behaviour of ineffective nodules and not cause; this absence cannot therefore be conside to prove that the pigment is necessary to nitro fixation in the nodule, though it may well be. T caution as to interpretation in no way detracts fr the great interest of the red pigment, or of its ide fication with hæmoglobin[3], or of Virtanen's obser tions on the change from red to green.

Secondly, Virtanen states that his ineffect nodules were found to contain bacteria in the stage. In nodules produced by all strains of *Rhizobi* that we have observed, the recently infected tis contains rod-shaped bacteria imbedded in the sli of the 'infection threads'. Similarly, in the integrated region of old nodules, such bateria remain are in the rod stage often imbedded in sli masses. In active effective nodules these rod-sha bacteria are not conspicuous because the region which they occur are small compared with the la volume of the central bacterial tissue, where bacteria within the cells of the host plant usually oc as swollen 'bacteroids'. But in ineffective nod this latter tissue has so short a life that in mos those observed at any one time it has either not formed or has already disintegrated; in both th conditions only rod-shaped bacteria are found. have observed, however, that the swollen 'bactero found during a short period in ineffective nodules in general similar in shape to those in effec nodules (see photomicrograph), though strain dif ences unrelated to effectiveness do occur[2]. It is t however, that the relation found by us of the quan of nitrogen fixed to the volume and duration of 'bacteroid'-containing tissue carries the implied s gestion that no detectable fixation occurs in th parts of the nodule where the bacteria are presen small rods, and is thus consistent with Virtan view. But in order to explain the behaviour of effective strains, it is necessary to discover why nodules produced by them fail to develop an adeq volume of the central tissue containing the swo



Strain *A* (effective) Strain 2027 (very ineffective)

BACTERIA FROM THE CENTRAL TISSUE OF CLOVER NODULES PRODUCED BY TWO STRAINS OF *Rhizobium*.

acteria or to maintain it from disintegration. This certainly the result of a maladaptation between the acteria and the plant, since individual plants can e found in which a normally effective strain of the acteria will behave ineffectively, and vice versa. It as found in this Department by P. S. Nutman npublished work) that *Trifolium pratense* possesses ecessive genes that produce a typical ineffective esponse with a normally effective strain of *Rhizobium*. ur results suggest that the ineffective response may e related to the induced production by the plant of ubstances inimical to the bacteria[4].

Changes in Effectiveness of Bacterial Strains

The abnormal responses given by plants possessing ertain genetical compositions do not produce any sting change in the bacteria. If these are re-isolated om such abnormal nodules and supplied to a normal lant, they will produce the degree of effectiveness pical of the original bacterial strain. It has been aimed by previous workers that continued passage rough the host legume will progressively alter the fectiveness of a bacterial strain. The negative esults of Virtanen's attempt to change the effectiveess of a strain in this way are in general agreement ith unpublished results obtained here, in which fective and ineffective strains of clover *Rhizobium* owed no progressive changes on lant passage, although they readily developed treme variants in effectiveness on culture in some erilized soils as well as under other laboratory onditions.

Infection by Mixed Strains of Nodule Bacteria

Investigations carried out at Rothamsted also have bearing on those of Virtanen relating to the succesve application to the host plant of two strains of *hizobium*. H. K. Chen[5] found that when different rains were supplied singly to the host plant, the umber of nodules per gram of root attained a limit at was specific to each bacterial strain, though the enetical analysis referred to above has shown that enes in the host plant *Trifolium* also control the umber of nodules formed.

As a consequence of this limit, the nodule-producing apacity of a root system can become so saturated at no more nodules will result from a further supply f bacteria whether of the original or of a different rain of *Rhizobium*[6]. This condition readily obtains ith peas and soy beans grown in pots, where the root system makes most of its growth in the first few weeks. In clover, the root system of which continues to grow during a long period, the nodules first formed did not inhibit further nodule formation by the same or by a different strain. No evidence could be found of specific immunization by the nodules of one strain against the entry of a different strain.

When two strains were simultaneously supplied in initially equal numbers to pot-grown peas, acute competition in the root surroundings resulted in the preponderance of one of the strains both outside the roots and in the plant. In similar experiments with clover, one pair of strains showed this selective competition; but with another pair, neither strain showed a selective advantage, the percentage of nodules produced by each strain being in proportion to the relative number produced respectively by the strains in pure culture.

The factors controlling competition between strains of *Rhizobium* in soil as well as those that limit the number of nodules produced afford interesting problems that are now under investigation.

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[3] Keilin, D., and Wang, Y. L., *Nature*, **155**, 227 (1945).

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[6] Nicol, H., and Thornton, H. G., *Proc. Roy. Soc.*, B, **130**, 32 (1941).

OBITUARIES

Prof. E. J. Williams, F.R.S.

THE death at the early age of forty-two of Evan James Williams, professor of physics at the University College of Wales, Aberystwyth, has taken from us one of the most brilliant physicists of our generation. When finally compelled by his fatal illness to give up his work at the Admiralty, Williams returned to the village of Llanwenog, near Llanybyther, in the heart of rural Wales, near the border of Cardiganshire and Carmarthenshire, where he and two brothers were born, and where his mother and his father, a master stonemason, still live.

Educated at Llanwenog National School and then at Llandyssul County School, as was his elder brother, now Dr. D. Williams, of the Aeronautical Structural Department of the Royal Aircraft Establishment, Farnborough, E. J. Williams quickly showed his brilliant qualities of mind. At the age of sixteen, by chance noticing in the local paper that some scholarships were open to competitive examination on the following day at Swansea, but finding the last train gone, Williams made the fifty-mile journey by pillion on his brother's motor-cycle, and won a £60 scholarship, and so began his academic career. From University College, Swansea, he went to Manchester to work under W. L. Bragg, then to Cambridge to work under Rutherford. After a year in Copenhagen with Niels Bohr, he returned to Manchester, and then went on to Chadwick at Liverpool. In 1938, he was elected to the chair of physics at Aberystwyth. In 1939, at the age of thirty-six, Williams was elected into the fellowship of the Royal Society.

Williams was distinguished both as an experimental and theoretical physicist. His experimental work was mainly concerned with studies of electronic and atomic collision processes, using the cloud chamber of C. T. R. Wilson. The most striking of his experimental achievements was the direct demonstration in 1940 by the cloud chamber method of the decay of a cosmic ray meson into an electron.

Skilful though he was as an experimenter, Williams' distinction lay perhaps even more in his rare gift of analysing in detail the mechanisms of complicated physical processes, using a minimum of mathematical analysis and a maximum of physical understanding. In this quality of mind he had something in common with Niels Bohr, in whose institute in Copenhagen Williams did some of his best work. In a series of papers on collision processes, chiefly in the *Proceedings of the Royal Society*, and particularly in a brilliant but little-known paper, "Correlation of Certain Collision Problems with Radiation Theory", published in Denmark in 1935, Williams showed these rare powers to the full. The development of what is now generally known as the Williams-Weiszäcker method of impact parameters, for the approximate treatment of atomic collision problems, has the valuable quality of revealing the underlying physical mechanisms, which are often obscured by the heavy mathematical machinery of more rigorous methods. A particularly fertile application of these ideas was made by Williams to predict the later verified logarithmic rise of ionization with the energy of a very fast particle. As applied to the simpler collision processes, the impact parameter method was at first sometimes thought of as only giving an approximate answer and a visualizable picture of what could be calculated exactly by orthodox quantum mechanical methods. However, in recent years it is coming to be more and more used in solving the very complicated problems of the collision of fast neutrons, protons and mesons; this is so just because the complexities of the problems have made solution by more rigorous methods either very difficult or nearly impossible.

During the War, Williams turned his powerful analytic mind to many of the most important problems of the U-boat war, and made contributions of decisive importance to the winning of the campaign. His first work in this field, made during the summer of 1941, lay in the analysis of the process of attack on U-boats by aircraft. Simple but penetrating arguments, based on the actual observed facts of such attacks and on theoretical reasoning about these facts, showed that certain changes in the depth-setting and spacing of the depth charges should lead to a striking improvement in the number of U-boats sunk. The changes were made and the predicted results were attained, thus revolutionizing the attacking power of Coastal Command aircraft.

During 1942 Williams, who was then head of the Operational Research Section of Coastal Command, studied in great detail the tactics of harassing the U-boats by aircraft during their passage through the Bay of Biscay on their way from their bases to their hunting grounds. It was largely due to Williams' keen analysis and powerful advocacy that an augmented and improved 'Bay Offensive' was staged in early 1943. The results, in terms of U-boats sunk, were not only in startling agreement with his predictions, but also were one of the important facto
that led to the defeat of the U-boat campaign in t
summer of 1943, and so made possible the seriou
planning of the invasion of Europe.

Part of the story of the technical battle of wits-
particularly in the field of radar—the victory
which made this 'Bay Offensive' successful, h
already been told. The tactical battle of wits, wage
by Coastal Command and the Admiralty staffs again
the U-boat command, were analysed with great insig
by Williams, working in close collaboration with t
Naval and Air Anti-U-boat Staffs. Some day, perhap
it may be possible to tell much more of this fascinati
story.

During the last months of his illness, when Willia
took up again his favourite subject of the quantu
theory of atomic collision processes, he confess
that he still found the subtle intricacies of the U-bo
war of comparable intellectual interest.

Scientific men of all lands will mourn the loss
this brilliant young Welshman. His death, coming
soon after that of R. H. Fowler, means a sad weake
ing of the none too wide ranks of British theoreti
physicists. P. M. S. BLACKETT.

Prof. Marc Tiffeneau

MARC TIFFENEAU was born at Mouy on Novemb
5, 1873. After leaving school he was apprenticed
a druggist in Sainte-Maxence for a year, after whi
he went to Paris, where he continued his training f
two years longer. Then he studied at the Éco
supérieure de Pharmacie, where at the same time
his friends Valeur and Blaise he came under t
influence of Béhal. After an academic career
exceptional brilliance, he acted for five years as
demonstrator in the department. By this time
had qualified as a pharmacist, and in this capacit
was attached for many years first to the Hôpit
Boucicaut and later to the Hôtel Dieu. In bot
those hospitals he had the good fortune to find amp
facilities for research, of which he took full advanta
for in due course he shared his enthusiasm for che
istry with a large band of ardent workers, amo
whom Orékhoff and Mlle. Lévy were outstanding.

Tiffeneau was a man with wide interests, and t
scientific aspect of medicine made a special appeal
him. It is characteristic of his versatility that
worked in Richet's laboratory and also at the Paste
Institute, where it was at the suggestion of Ro
that he decided to qualify in medicine. In 1907
obtained his doctorate in science, and in 1910 h
doctorate in medicine. He was elected to a chair
chemistry at the Hôtel Dieu in 1924, and to a cha
of pharmacology and materia medica at the Sorbon
in 1926; for a man to have held at the same ti
those two important chairs, and to have achiev
distinction in each, is surely exceptional. In 19
he was Dean of the Faculty of Medicine of t
University of Paris. He was honoured by his electi
into the Académie de Médecine in 1927 and by h
selection as member of the Institut de France in 19
in succession to Urbain. He was also an Officier de
Légion d'honneur. At the time of his death on M
20, 1945, he was president of the French Chemic
Society. His wife, a sister of Prof. Fourneau, surviv
him with two sons.

After Fittig discovered the pinacol transformati
in 1859, the mechanism of this action as well as th
of the dehydration of glycols of various typ

racted the attention of many chemists the world r, and among those chemists Tiffeneau takes a ding place. Indeed, no one more than he had loited this important aspect of molecular re- angement so exhaustively and with greater experi- ntal skill and ingenuity. Some conception of his nprehensive outlook may be gathered from a rusal of the elaborate résumé on glycols which he ote for the "Traité de Chimie" edited by Grignard, pont and Locquin. By his studies on the semi- drobenzoin and semipinacolinic transpositions as ll as on the vinyl dehydration of glycols, he threw ich light on the question of distribution of affinity molecules. Further, the reaction of semipinacolinic amination furnished him with an excellent means contrasting the migrational aptitude of hydro- bon radicals. Among the numerous topics which investigated may be mentioned the isomerization epoxides, the elimination of halogen from iodo- drins, and the stereochemistry of compounds of e type of ethylhydrobenzoin. Dealing more par- ularly with hypnotics and anæsthetics, he advanced pharmacology by his work on the relationship between chemical constitution and physiological action, and he also experimented with the effects of adrenaline, ephedrine, hordenine, organic compounds of mercury, and many other substances.

Like Pasteur, Tiffeneau was a keen French patriot, and during the occupation of Paris by the Germans he did much to keep the spirit of research alive in the University. The news of his sudden death came as a blow to his many friends, who are not unmindful of what they owe to his inspiration.

ALEX. MCKENZIE.

WE regret to announce the following deaths:

Dr. F. W. Aston, F.R.S., fellow of Trinity College, Cambridge, on November 20, aged sixty-eight.

Dr. H. E. Durham, who took part in various expeditions to study tropical diseases, and in recent years was supervisor of the laboratories of H. P. Bulmer and Co., Ltd., on October 5, aged seventy-nine.

NEWS and VIEWS

obel Prize for Chemistry for 1944: Prof. Otto Hahn

PROF. OTTO HAHN, to whom the Nobel Prize for nemistry for 1944 has been awarded, in recognition his discovery (with F. Strassmann) of the neutron- duced fission of uranium and thorium (in its emical aspects), has for long been universally cognized as the outstanding 'radioactive' chemist his generation. Born sixty-six years ago, he began s studies in radioactivity in his early twenties under r William Ramsay at University College, London, oceeding from there, as Soddy had done previously, work for a time with Rutherford in Montreal. In ondon he discovered radiothorium, an intermediate oduct between thorium and thorium X, and in ontreal radioactinium—and also carried out purely ysical experiments on the magnetic and electric flexions, and on the ranges, of the α-particles from orium C. Having returned to Berlin (1906), he olated mesothorium 1 (1907) and mesothorium 2 908), and from that date he continued to contribute gularly to—and in general to lead—the great lvances in specialized chemical technique required r pioneering work with the heavy radioactive ements. His thirty years association with Lise eitner (1908–38) provides a classical example of the ppy collaboration of chemist and physicist to the utual advantage of both sciences. It was terminated ly by the rigour of the laws of racial discrimination hich were enforced in Hitler's Germany. No doubt is more than a slight consolation in the face of aposed separation that Meitner and Hahn should ich have been able to contribute, one on the physical, e other on the chemical side, to the original ucidation of the problem of uranium fission. uring the War, Hahn continued to work on the emical side of this problem and many of the sults which he and his colleagues obtained ere permitted full publication by the German nsor.

The award of the Nobel Prize is a fitting tribute to scientific achievement of immense range and singleness of purpose: Hahn may have missed the broader generalizations, the displacement law, the significance of nuclear isomerism—although he discovered the first recorded instance of this phenomenon (1921) and established its essential features as the result of masterly experimentation, he may, in later years, have been in possession of the clue to fission before he would admit it even to himself, but no single man has done more for his subject. In 1906, Rutherford wrote ("Radioactive Transformations", p. 69) "the results so far obtained by Hahn are of the greatest interest and importance"; his subsequent discoveries, over a period of forty years, have maintained that high standard throughout.

Nobel Prize for Physics for 1945: Prof. Wolfgang Pauli

THE Nobel Prize for Physics for 1945 has been awarded to Prof. Wolfgang Pauli, of the Federal Technical Highschool at Zurich, which before the War became through him a centre of theoretical physics. When the danger of a German invasion seemed imminent, he went to the Institute for Advanced Study, Princeton. Among the many brilliant disciples of Sommerfeld, Pauli and Heisenberg are the most outstanding. While he was a student, Pauli wrote the article on the "Theory of Relativity" for the "Mathematical Encyclopedia" which, to this day, is one of the best presentations of this subject. He took an active part in Bohr's interpretation of atomic spectra in terms of quantum theory, and he was the first to attribute to the electron, apart from its three ordinary quantum numbers, a fourth one, $s = \pm \frac{1}{2}$, which was, soon afterwards, recognized by Goudsmit and Uhlenbeck to be the angular momentum (spin). This led Pauli to his main discovery, the exclusion principle; originally derived from experimental facts about spectra (of helium and other atoms) it turned out to be one of the most general rules of quantum theory. It served Bohr as the main tool in his explanation of the periodic system of the elements. After Bohr's theory of electronic structures was superseded by quantum mechanics, Pauli's principle found its natural place in it as the postulate that the wave function of several electrons is skew in the co-ordinates of these. Later, Pauli has shown the close connexion between his principle and the statistics of ensembles, namely, that particles with integral spin (photons, mesons) satisfy Bose–Einstein statistics, while particles with half-integer spin (electrons, protons) satisfy Fermi–Dirac statistics.

Pauli also took part in the development of matrix mechanics. He was the first to treat the hydrogen atom by matrices, and he showed how in non-relativistic approximation the spin of the electron could be represented by a set of matrices, so paving the way for Dirac's relativistic theory of the electron. He has published papers on nuclear physics (hyperfine structure), equilibrium of radiation and molecules, paramagnetism of metals, quantization of field equations (with Heisenberg), wave equations of particles with higher spin, entropy in quantum statistics, and similar subjects.

Charles Chree Medal and Prize of the Physical Society: Dr. J. A. Fleming

THE Council of the Physical Society has awarded the third (1945) Charles Chree Medal and Prize to Dr. John A. Fleming; the presentation will be made on December 6. From about 1905 onwards, Dr. Fleming was the principal colleague of the late Dr. L. A. Bauer, the initiator and first director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, whom he succeeded in 1932 as director and also as editor of the international journal *Terrestrial Magnetism and Atmospheric Electricity*. Dr. Fleming has been president of the International Association of Terrestrial Magnetism and Atmospheric Electricity of the Union of Geodesy and Geophysics since 1944 and general secretary of the American Geophysical Union from its inception.

Dr. Fleming's Department is the only institution in the world devoted to the study of terrestrial magnetism in all its aspects; and under him its work has been extended in new directions, including a wide programme of ionospheric study and both theoretical and experimental investigations in nuclear physics. The field-work undertaken by the Department has contributed greatly to the knowledge of the earth's magnetism where no magnetic surveys have been made and no permanent magnetic observatories exist. Much of this observational work was done under Dr. Fleming's direction; he controlled the organization and equipment of the teams of observers on land and shared in the design and the voyages of the non-magnetic ships *Galilee* and *Carnegie*, which made extensive magnetic surveys of the oceans for some twenty years, and in the planning and institution of the Department's magnetic observatories at Watheroo (Western Australia) and Huancayo (Peru). He has also helped and encouraged magnetic and atmospheric electric observation by official or private agencies in many lands. But for his work our knowledge of the state of the earth's magnetic and electric fields during the past forty years would be materially less than it is. He has also organized and stimulated the geomagnetic and electric researches undertaken by his Department, and notably in the elucidation of the short-lived magnetic effects associated with radio fade-outs and solar eruptions, and, in recent years, in radio scien Though it is not possible always to separate t work of Dr. Fleming from that of his staff, the uniq position which the Carnegie Institution maintai in the investigations of all the problems of terrestr magnetism is unquestionably due to his wise guidan and inspiring leadership.

Science Museum: Retirement of Col. E. E. B. Mackinto

THE many friends of Colonel E. E. B. Mackinto will learn with regret of his retirement from t position of director and secretary of the Scier Museum on November 30, on reaching the age lim He has held this position with distinction since 19 when he took over the directorship from Sir Hen Lyons, soon after the latter had successfully launch the Children's Gallery and introduced the idea special exhibitions. He extended and developed bo these features, and by 1939 had succeeded in evolvi an attractive and fascinating gallery, specially d signed and arranged for the younger visitors, a providing a most instructive elementary introducti to many branches of science. He has explored t possibilities of different types of special exhibitio and for a number of years has devoted one of t main galleries of the Museum entirely to this purpos During the period 1933–39, some thirty-five speci exhibitions were held in the Museum, not a few which met with outstanding success, and there no doubt that the policy of holding these speci exhibitions has been well justified. Under Colon Mackintosh's direction, the Science Museum co tinued to maintain and even to improve its positi in the forefront of the national museums and galleri of Britain, until the War necessitated its closure. Tl main task of the Museum at this time was to ensu the safety of its contents—objects, archives ar records alike—and Colonel Mackintosh succeeded dispersing approximately two thirds of the collectio together with more than 100,000 volumes from tl Science Library, to thirty isolated country house A selection of these possessions is now being broug back to London, in preparation for the partial r opening of the Museum. Colonel Mackintosh w have the good wishes of his many friends in h well-earned retirement.

Dr. H. Sha

THE Ministry of Education has announced t appointment of Dr. Herman Shaw as director ar secretary of the Science Museum as from December in succession to Colonel E. E. B. Mackintosh. T appointment of a professional man of science to th important office is a departure from past practic and will be generally welcomed. Dr. Shaw receiv his education at Bradford Grammar School and t Royal College of Science, where he studied physic During the First World War he served in the Roy Naval Air Service. He joined the staff of the Scien Museum in 1925, and later became 'keeper' of physic His special interest in physical research has been geophysics, and he was awarded the degree of D.S of the University of London for a geophysical resear using the Eötvös pendulum. He has long be associated with the Physical Society, of which present he is the acting treasurer; he also took active share in the organization of the Edinbur meeting of the International Union for Geodesy ar Geophysics in 1936.

Phillip Morris : Vice-Chancellor, University of Bristol

IT has recently been announced that the successor Dr. Thomas Loveday as vice-chancellor of the iversity of Bristol is to be Mr. Phillip Morris, the sent director-general of Army education. Mr. rris was appointed to the latter post in February 44 in order to co-ordinate the work of the Director-s of Army Education and the Bureau of Current fairs. He was educated at Tonbridge, St. Peter's, rk, and Trinity College, Oxford, and, after gradua-n, spent some time on the teaching staff of West-inster Training College. There he decided to take educational administration and joined the staff the Kent Education Committee as assistant educa-n officer. In due course he was promoted to istant director and in 1938 succeeded Mr. Salter vies as director of education. There, in the early ars of the War, he began those first contacts with my education which finally led to his accepting e position of director-general. While carrying out ese duties he won the admiration and respect of his colleagues. He combined a breadth of vision d acuteness of mind with an administrative ability ich is quite unusual. He went into the War Office a time when few regular soldiers would have dared say that they understood the organization and ministration of the modern army; he not only rprised everyone by the rapidity with which he asped the situation but also by the insight which brought to bear upon the problem of the Army's ucational needs. The comprehensive educational heme for the Army which is now in being is, to the derstanding person, a monument to Morris's keen-ss and ability. Mr. Morris hopes to take up his w appointment in January 1946. We wish him ery success in a post which, in the coming years, ll make great demands on his administrative ilities.

Chemical Research at Leeds

THE retirement of Prof. Whytlaw-Gray from the air of chemistry in the University of Leeds after tenure of twenty-two years (see *Nature*, Sept. 29, 386) will not mean his withdrawal either from the niversity or from active research; for the Lever-lme Trustees have awarded him a grant which will able him to devote himself wholely to research. n account of the accurate work on gases which s been carried out in the Chemistry Department Leeds over a number of years by Prof. Whytlaw-ay and his collaborators, Imperial Chemical Indus-es, Ltd., have recently made a generous offer to e University to finance and support a fundamental ece of research on the behaviour of gases and gas ixtures under high pressures and temperatures. is work will be undertaken by Dr. J. Colvin and r. J. Hume at the desire of Prof. Whytlaw-Gray. e firm will provide apparatus specially designed d made for this work at an estimated cost of £3,500, d will make an annual grant to cover the expenses the work. This invitation to Prof. Whytlaw-Gray's lleagues, following the establishment of the I.C.I. lowships, is additional evidence of the Company's nviction that industry should support the search ter knowledge for its own sake, which is so important part of the work of a university. Although the mpany is interested in this work in so far as it es gases at high temperature and pressure in me of their commercial processes, the research will not be directed with the view of producing commercially valuable information, since it is intended to provide fundamental knowledge; no restriction is imposed on the carrying out of the work or the publication of the results.

Chemical Engineering at the University of Leeds

A GIFT by Mr. Charles Brotherton of £55,000—£50,000 of which is under a seven-year covenant—to provide a new chemical engineering laboratory was announced at a recent meeting of the Council of the University of Leeds. The benefaction is in keeping with the recognition of the importance of the subject now general in Great Britain; the Universities of London and Cambridge have also benefited recently by endowments to provide for this field of study. The Department of Coal Gas and Fuel Industries with Metallurgy, which provides the course in chemical engineering, was established in 1906 to give training in fuel and metallurgy. In 1910 a degree in gas engineering was introduced, following the endowment of a chair by the British gas industry to perpetuate the memory of Sir George Livesey; this was followed later by contributions to a building fund. The degree course in gas engineering has been largely chemical engineering in character, and it was provided at a time when the latter subject met with little academic recognition. In 1942, the scope of the curriculum at Leeds was widened, and a four-year degree course in chemical engineering added to meet the needs of those passing either into the contracting side of the gas industry, or into the chemical industry generally. Among many other generous gifts to the University, Mr. Brotherton has already given liberal support to chemical and gas engineering. In 1942 he provided four undergraduate scholarships, and in 1943 a research assistantship; in 1944 he made a donation of £1,000 for equipment and £1,000 a year under a seven-year covenant for a Brotherton lectureship. Dr. J. S. Forsyth, at present Brotherton research assistant in chemical engineering, has now been appointed Brotherton lecturer in the University.

Research Fellowships in Engineering and Science

IN recognition of the increasing mutual dependence of universities and industry, Messrs. Turner and Newall, Ltd., of Rochdale, Lancs, manufacturers of asbestos, magnesia and allied products, have decided to give the necessary funds to provide a total of eight research fellowships in engineering, inorganic chemistry or physics or allied sciences. The fellowships will be financed by them for a period of seven years, and are to be established at specified universities in areas in which the company has certain of its larger factories; they will be known as 'Turner and Newall Research Fellowships'. The fellowships will be distributed among the following universities: Manchester (four), London (two), Leeds (one) and Durham (one). They will be of a normal value of £600 a year each, and the Universities will accordingly receive a total sum of £33,600 over the seven-year period for this purpose.

Science and War

PROF. J. D. BERNAL delivered a Friday evening discourse at the Royal Institution on November 23 on "Lessons of the War for Scientists". He said that the share that science had in the war effort can well be balanced by the contribution of the experience of war both to fundamental and applied science in times of peace. The War provided full-scale experience of organized science with the advantages of an over-all directing purpose and without the limitations of shortage of funds and apparatus. Not only was it found possible to apply existing discoveries to practical uses in a far shorter time, but also it was possible to carry out fundamental researches which revealed new factors underlying practical experience, such as, for example, the theory of shock waves and blast. A high degree of integration was reached between scientific men working in different fields, as also in different countries; and this was enormously facilitated by an improved organization of communication and by far greater facilities for travel and visits between men of science. Further, a directing organization of scientific committees grew up, which went far to combine principles of planning and freedom which had often been claimed to be incompatible.

This experience, Prof. Bernal said, extends and confirms what has already been claimed as to the advantages of improved organization and greater facilities for science; but in addition to this, the experiences of the War produced entirely new concepts of the relations between science and practical activities. These evolved, in the first place, out of the use in the field of complicated scientific apparatus, and became towards the end of the War the scientific examination of the objects and purpose of warfare and protection that we have come to know as 'operational research'. Operational research unites, on one hand, the physical, biological and social sciences in the most intimate way, and, on the other, integrates the scientific with the economic and technical fields. The problem that we have now to solve is how to conserve all the advantages and the lessons we have had from war science to deal with the problems of peace, where, though the urgency is not so violent, there is a far greater diversity of problems and a far greater need to take the various and often conflicting desires of people into account.

World Power Conference

A MEETING of the International Executive Council of the World Power Conference was held during November 20–21, to discuss the post-war revival of the activities of the Conference. Sir Harold Hartley, the chairman of the Executive Council, presided; some twenty countries were represented, including Australia, Belgium, Canada, Czechoslovakia, Denmark, France, Great Britain, India, Ireland, Luxemburg, Mexico, the Netherlands, New Zealand, Poland, South Africa, Sweden, Switzerland and the United States. Mr. Harold Hobson, chairman of the Central Electricity Board, led the British delegation. It was decided to hold, if possible, a sectional meeting in 1947 to discuss the general question of fuel economy; the place of this meeting will be decided at a meeting of the Council to be held in Paris next spring. Before the War the Conference published a statistical yearbook containing data on all sources of energy, giving both natural resources and annual production; publication will be resumed as soon as possible. The following resolution was passed unanimously: "In view of the future significance of atomic energy over the whole range of power problems this Council resolves to appoint a small committee to watch developments and to make recommendations to the International Executive Council of the World Power Conference as soon as it is practicable to have an effective discussion of the utilisation of atomic energy for industrial and domestic purposes".

The Night Sky in December

NEW moon occurs on December 4d. 18h. 06m. U and full moon on Dec. 19d. 02h. 17m. The followi conjunctions with the moon take place: Dec. 3d. 09 Venus 2° S.; Dec. 20d. 21h., Saturn 2° S.; De 21d. 12h., Mars 0·7° N.; Dec. 27d. 21h., Jupit 4° S. In addition to these conjunctions with t moon, Mercury is in conjunction with Venus Dec. 13d. 04h., Mercury being 2·1° N. Occultatio of stars brighter than magnitude 6 are as follow Dec. 17d. 18h. 26·0m., ε Taur. (*D*); Dec. 31d. 6 50·1m., ν Scor. *m* (*D*). *D* refers to disappearance, a the times are for Greenwich. Mercury is in inferi conjunction with the sun on Dec. 7 and is stationa on Dec. 17. The planet sets about 35 minutes after t sun at the beginning of December and rises abo one and a half hours before the sun at the middle a end of the month. Venus rises at 6h. 22m., 7h. 04 and 7h. 42m. at the beginning, middle and end of t month respectively. Mars, in the constellation Cancer, can be seen throughout the night, rising 19h. 45m. on Dec. 1 and at 17h. 13m. on Dec. 3 The planet is stationary on Dec. 5. Jupiter, in t constellation of Virgo, can be seen in the early mor ing hours, rising at 3h. 11m. on Dec. 1 and 1h. 38 on Dec. 31. Saturn, in the constellation of Gemi can be seen in the evening hours, rising at 19h. 11 on Dec. 1 and at 17h. 02m. on Dec. 31. There w be a total eclipse of the moon on Dec. 18–19, visib at Greenwich. The circumstances of the eclipse a as follows:

Moon enters penumbra ..	Dec. 18d.	23h.	38.4m.
Moon enters umbra ..	19	00	37.5
Total eclipse begins ..	19	01	40.5
Middle of eclipse	19	02	20.3
Total eclipse ends	19	03	00.2
Moon leaves umbra ..	19	04	03.1
Moon leaves penumbra ..	19	05	02.3

The winter solstice occurs on Dec. 22d. 05h. Th Geminid meteor shower reaches a maximum abo Dec. 12–13.

Announcements

SIR JOHN ANDERSON will deliver his postpone address on "Research in Relation to Reconstruction in the Whitworth Hall of the University of Ma chester on December 6. The meeting has bee arranged by the Manchester Joint Research Council cards of admission are obtainable from the Secretar of the Council, c/o Manchester Chamber of Commerc Ship Canal House, King Street, Manchester 2.

THE Lords Commissioners of the Treasury hav approved the appointment of Mr. W. F. Grime formerly of the National Museum of Wales, Cardi to be keeper and secretary to the London Museu from December 1.

DR. JAMES GREIG has been appointed to th University chair of electrical engineering tenable a King's College, London, as from October 1. Durin 1926–39 Dr. Greig was lecturer in electrical enginee ing at the University of Birmingham, and since 193 he has been head of the Engineering Department a Northampton Polytechnic.

THE Society for Visiting Scientists, 5 Old Burlingto Street, London, W.1, has arranged a series of meeting to discuss the organization of research within th British Commonwealth. Each area will be dealt wit by speakers having special knowledge of it. Th meetings will be held at 7.30 p.m. on December (India and the Colonies), December 19 (Australia an New Zealand), January 9 (Canada and South Afric and January 23 (Great Britain).

LETTERS TO THE EDITORS

he Editors do not hold themselves responsible or opinions expressed by their correspondents. Vo notice is taken of anonymous communications.

opagation and Termination Coefficients for Vinyl Acetate Photopolymerization

MOST vinyl derivatives polymerize to macro- ecules by means of the well-recognized chain chanism in which the monomeric molecules are ivated thermally, by catalysts or by radiation. is step is followed by the addition of molecules monomer, the so-called propagation step, and ally the activity may be removed by a variety of ys leading to the termination of growth of the ymer. In many such reactions termination of wth occurs by mutual reaction between the two ive polymers. In this case it is easy to show that

$$- d(M)/dt = k_p(M)(I/k_t)^{1/2},$$

ere $- d(M)/dt$ is the rate of disappearance of nomer, I is the rate of activation of monomer k_p is the average value of the bimolecular velocity fficient for the interaction of active polymer and nomer and k_t is the termination velocity coefficient. transfer is excluded, the chain-length ν is $M)/(Ik_t)^{1/2}$. Thus measurements of the rate and the chain-length will enable $k_p/k_t^{1/2}$ to be determ- d. No matter how the experiments are conducted, y *two* quantities can be measured, whereas there *three* variables concerned in these complex re- ions. Complete analysis of the kinetics of the ction is therefore impossible. The following tech- que has made it practicable to overcome this funda- ntal difficulty and to learn a good deal more about mechanism of polymerization.

According to the above general theory, we have relationship that

$$- d(M)/dt = k_p(P)(M),$$

ere (P) is the total active polymer concentration. rther, we have that $I = (P)/\tau$, where τ is the mean of the active polymer. Thus if I and τ can be ermined, k_p and k_t can be computed by substitu- n in the above equations. The photochemical uid phase polymerization of vinyl acetate proved be a suitable reaction for this purpose. In this e, $- d(M)/dt$ is proportional to the square root the intensity of the absorbed radiation. τ can, this circumstance, be measured by the rotating tor method, and, in a typical experiment, had a ue of $2{\cdot}25 \times 10^{-2}$ sec. I was determined by the ndard inhibition technique. *p*-Benzoquinone is ecially useful for this purpose since it gives rise a well-marked induction period followed by a rate olymerization precisely equal to that of the un- ibited reaction.

t turns out that each quantum of absorbed radiation rts off a polymer chain. In the experiment above, $= 6{\cdot}3 \times 10^{-7}$ einstein sec.$^{-1}$ litre^{-1}. At 15·90° C., $l(M)/dt$ was $8{\cdot}3 \times 10^{-6}$ moles sec.$^{-1}$ litre^{-1}. Thus, $= 5{\cdot}86 \times 10^2$ litre moles^{-1} sec.$^{-1}$. These experi- nts were repeated at different temperatures in er to obtain the energy of activation for propaga- , which amounts to 4,400 cal. Hence the tempera- e-independent factor for k_p has a value of 5 × 10^6 litre moles^{-1} sec.$^{-1}$. If we assume the mal value of this factor to be 10^{11}, then this ld imply a steric factor of about 10^{-5}, which is reasonable having regard to the nature of this type of reaction.

From the theory, $k_t = (k_p^2(M)^2I)/(- d(M)/dt)^2$. The value of k_p is then inserted in this equation and k_t is $3{\cdot}04 \times 10^9$ litre moles^{-1} sec.$^{-1}$.

Experiment shows that *no* energy of activation is required for the termination reaction, and hence the steric factor will have a value of about 10^{-2}. These measurements refer to a chain-length of 1,250. All these experiments were repeated at a chain-length of 2,500 by reducing the intensity of the light to a quarter of its original value, τ increasing to $5{\cdot}51 \times 10^{-2}$ sec. Under these conditions, $k_p = 5{\cdot}56 \times 10^2$ and $k_t = 2{\cdot}86 \times 10^9$. In spite of the large increase in chain-length, it will be seen that the values of k_p and k_t are not much affected. Further, the ratio of these constants remains unaltered, which is very convenient when dealing with the detailed theory of the reaction.

The number average molecular weight of these photopolymers was determined by Mr. C. R. Masson (details will be published in a separate communication) in this laboratory, and it is interesting to note that they agree to within 5 per cent of the kinetic chain-length. This shows quite conclusively that no transfer reaction takes place under these conditions. In addition, these figures prove that when the active polymers mutually destroy each other's activity, they do not link up but remain separate particles.

These facts could be readily explained by assuming that the active polymers are free radicals, but such experiments do not necessarily indicate conclusively the nature of the active particle.

Full details of these experiments will be published elsewhere.

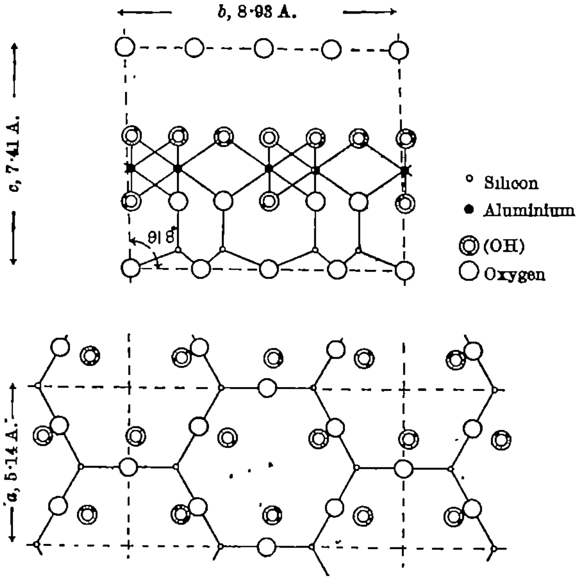
G. M. BURNETT.
H. W. MELVILLE.

Chemistry Department,
University of Aberdeen.
Sept. 20.

Structure of Kaolinite

THE generally accepted structure of kaolinite was elucidated by Gruner[1] from X-ray powder photographs, and Hendricks[2] afterwards gave confirmatory data obtained by electron diffraction. They find a monoclinic structure with cell dimensions $a = 5{\cdot}14$ A., $b = 8{\cdot}90$ A., $c = 14{\cdot}51$ A., $\beta = 101°\ 30'$, consisting of sheets of Si-O tetrahedra and Al-OH octahedra arranged parallel to the basal plane (001), there being two sheets in each unit cell. Gruner based his structure on measurements of some forty reflexions. Other workers[3] have since published lists of kaolinite reflexions aiming at higher accuracy in the spacing measurements rather than increasing the number of recorded reflexions. Apart from the work of Hendricks, we know of no further attempt to study the structure of the mineral since the publication of Gruner's analysis.

We have recently had occasion to examine in detail the X-ray powder diagram of kaolinite under conditions of higher resolution than Gruner employed; using a 20-cm. diameter focusing camera and a 12-cm. diameter cylindrical camera, we have recorded some seventy reflexions. Among the lower-order reflexions in particular we find additional lines to those recorded by Gruner, and attempts to reconcile them with a monoclinic cell failed completely. We were finally led to examine the possibility of a triclinic



cell. The observed reflexions can be accounted for satisfactorily by the following triclinic cell:

$a = 5·14$ A. $\alpha = 91·8°$
$b = 8·93$ A. $\beta = 104·5°$
$c = 7·41$ A. $\gamma = 90°$

This differs from Gruner's cell in that it is only pseudo-monoclinic and, having half the height, contains only one Si-O, Al-OH sheet. The structure of the sheet, shown in the upper part of the accompanying diagram, is that given by Gruner; the lower part of the drawing shows the relation between the basal oxygen atoms of the cell and the OH layer of the cell immediately *below* and may be compared with similar diagrams given by Hendricks[4] for the other kaolin minerals, dickite and nacrite, which show a closely similar relation between the two adjacent layers. Calculation of the reflected intensities for the ideal structure (that is, assuming regular tetrahedra and octahedra) shows general agreement between the observed and calculated intensities. A more detailed study of the actual deviations from the ideal structure is in progress.

The triclinic character of the lattice results in many more reflexions than would occur if the structure were strictly monoclinic, and provides a general explanation for the broadness of many of the observed lines, which are composite, and also (at least, in part) for the weakness of many of the lines as compar for example, with those from dickite, a strictly mo clinic kaolin mineral.

LATTICE SPACINGS, *d*, AND OBSERVED INTENSITIES, *I*, OF X-RAY REFLEXIONS FROM KAOLINITE.

Present values		Gruner's values	
d	*I*	*d*	*I*
7·133	10	7·13	10
4·460	4		
4·354	5	4·39	6
4·176	5	4·21	3
4·128	3	4·02	4
3·844	4		
3·733	2	3·76	4
3·567	15	3·57	10
3·368	3	3·35	½–1
3·148	1		
3·094	1	3·08	½–1
2·740	2		
2·556	4	2·556	5
2·527	2		
2·486	4	2·491	5
2·376	2	2·373	2
2·333	6	2·341	8
2·286	4	2·272	5
2·242	1		
2·183	2	2·200	½

A comparison of our results with those of Gru for the lower order reflexions is given in the acco panying table.

Whether the kaolinite examined by Gruner ha different structure from the specimens we h examined is for the moment left an open questi We are examining a large number of kaoli specimens from widely different localities, and so they have confirmed our results given above, wh were obtained from a sample of specially puri Cornish china clay; none has so far confir Gruner's data.

Note added in proof. We have now exami fifteen kaolinites from different localities, and results confirm those given above.

G. W. BRINDLEY
KEITH ROBINSON

Physics Laboratories,
University of Leeds.
July 26.

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[1] Gruner, J. W., *Z. Krist.*, 83, 75 (1932).

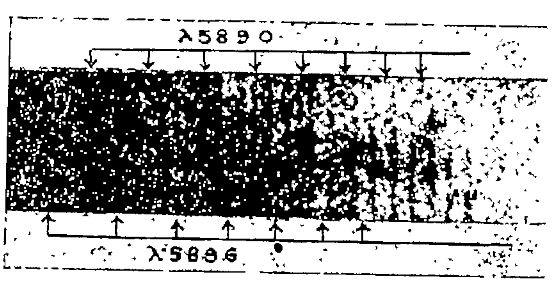
[2] Hendricks, St. B., *Z. Krist.*, 95, 247 (1936).

[3] Nagelschmidt, G., *Z. Krist.*, 87, 120 (1934). Favejee, J. Ch. *Z. Krist.*, 100, 425 (1939).

[4] Hendricks, St. B., *Z. Krist.*, 100, 509 (1939), vide Fig. 2, p. 517.

Splitting of the Sodium Doublet Lines

WHILE demonstrating the interference patter of various lines by means of a Hilger C. instrument in conjunction with a Lummer-Gehrc plate, a Philips 'Philora' sodium vapour la was used to produce the patterns of the sodiu doublet λ 5890/96. This lamp is in the form of U-tube enclosed in an outer vacuum jacket and excited by 230 V. A.C. mains through the usu electric control gear. The lamp usually takes abo 10–12 minutes to reach its maximum intensity. the first few minutes, each of the two lines show its normal monochromatic interference pattern sharp fringes; but as the lamp got heated and acquir its steady state of illumination, the fringe system both the lines presented a complex appearance. follow this development of complexity, the lamp w switched off for some time to cool down and th restarted. The fringe pattern was viewed throu the telescope from the time it was switched on. the lamp gained its full wattage (65 W.), each of t fringes in the two wave-lengths began to broad out and ultimately developed almost symmetric splitting into two defined components. The magnitu of the actual splitting computed from measureme is, within the limits of experimental errors, 0·064 for λ 5890 and 0·053 A. for λ 5896.



At first sight, this effect suggests self-reversal com-aed with pressure broadening; but the discharge nditions were not quite favourable for partial self-sorption. As Finkelnburg[1] points out, self-reversal y also be a consequence of partial pressure of tallic vapour in the path of discharge; absence self-reversal may leave the lines merely broadened, ring a diffuse appearance of continuous spectrum to e fringes, which is not the case found here. If, how-er, a genuine self-reversal is assumed, it would be ite interesting to investigate the broadening in this rticular case owing to the nature of the radiation urce. As shown by Watson[2], broadening may be aced to a number of factors: (*a*) radiation damp-g, (*b*) Doppler effect, (*c*) resonance between similar oms, (*d*) effect of foreign perturbers of van der aals type, any one or several together contributing the effect.

On the other hand, if self-reversal is ruled out, we ght interpret the observed phenomenon as a litting of the Stark effect type by foreign perturbers ere neon) carrying permanent fields. There is idence in favour of this type of broadening by ter-atomic or inter-molecular fields resulting from en mild electrical excitation. Merton[3], Hulbert[4] and nkelnburg[1] have recorded inter-atomic Stark fects of the Balmer lines of hydrogen, and Finkeln-urg[1] has deduced from the observed broadening the ectric fields at various pressures. The great line-eadths of Hg in high-current discharge by strong ter-atomic or ionic fields have been observed by nauss and Bryan[5]. Even splitting of the λ 2537 Hg sorption line into two broad components in solu-ons has been shown by Reichardt and Bonhoeffer[6]. Other similar lamp sources such as mercury and dium (another pattern) examined in this way show mparable splitting or broadening effects of smaller or rger magnitude. It is not possible at this stage to y what the predisposing causes of the phenomenon e, until complete experimental analysis under de-ied conditions is available. This is being undertaken.

N. R. TAWDE.
B. S. PATIL.
G. K. MEHTA.

Physics Laboratories,
Royal Institute of Science,
Bombay. June 5.

. *Phys.*, **70**, 375 (1931).
'*ev. Mod. Phys.*, **8**, 22 (1936).
'*roc. Roy Soc.*, A, **92**, 322 (1915).
'*hys. Rev*, **22**, 24 (1923).
'*hys. Rev.*, **47**, 842 (1935).
. *Phys.*, **67**, 780 (1931).

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nhancement of the Action of Immune Hæm-Agglutinins by Human Serum

EXPERIMENTS to determine whether human mplement plays a part in the specific agglutination human erythrocytes by immune serum revealed an teresting phenomenon. The titration end-point of e immune iso-agglutinin chosen for the experiment s found to be considerably increased when certain mpatible human sera, diluted 1 : 3, were used in ace of saline as a diluent for the iso-agglutinin. When turally occurring iso-agglutinin was titrated in rum, however, the titre was found to be the same that observed using saline as diluent (see Table 1). Seventy-seven immune sera, comprising 49 anti-*Rh*, anti-*Rh* sub-group, 14 anti-*A*, 1 anti-*B*, 3 anti-A_1 (*alpha*$_1$), 2 anti-*M* and 1 anti-*N*, were titrated in serum and in saline. The degree of agglutination as measured by the size and firmness of the masses of agglutinated cells was in each instance much more pronounced when serum was employed for dilution than when saline was used, and in 73 of the 77 specimens there was also a definite increase in titre. Frequently, however, the limit of agglutination in serum was observed to extend to not more than one or two tubes beyond the limit of agglutination of the saline control series.

TABLE 1.

Titre	Immune iso-agglutinin		Naturally occurring iso-agglutinin	
	Saline	Serum	Saline	Serum
1	*c*	*c*	*c*	*c*
2	*v*	*c*	*c*	*c*
4	+	*v*	*v*	*v*
8	(+)	*v*	+	(+)
16	*w*	*v*	*w*	*w*
32	—	++	—	—
64		(+)		
128		(+)		
256		*w*		
512		—		

Read macroscopically: *c* = complete agglutination; surrounding fluid clear. *v* = visual agglutination; surrounding fluid pink.
Read microscopically: ++ = very large clumps; + = large clumps; (+) = smaller clumps with many free cells; *w* = clumps of 4–5 cells; — = no agglutination.

Fourteen naturally occurring agglutinins, which included 5 anti-*A*, 4 anti-*B*, 4 anti-A_1 (*alpha*$_1$), and 1 anti-0, were also examined. Two of the anti-A_1 (*alpha*$_1$) sera were prepared by absorption of group *B* sera with A_2 cells and two were from group A_2B persons. The anti-0 serum was an absorbed cattle serum. In no instance was there any increase in either the degree of agglutination or in the titre when serum was used as diluent in place of saline. The results are summarized in Table 2.

TABLE 2.

Iso-agglutinin	Total no. tested	No. showing increase in titre	No. showing *no* increase in titre
Immune anti-*Rh*	49	46	3*
Anti-*A*	14	13	1*
Anti-*B*	1	1	0
Anti-A_1	3	3	0
Anti-*M*	2	2	0
Anti-*N*	1	1	0
Naturally occurring anti-*A*	5	0	5
Anti-*B*	4	0	4
Anti-A_1 (α_1)	4	0	4
Anti-0	1	0	1

* These sera showed an increase in degree of agglutination, without an increase in titre being observed.

An immune *Rh* serum was titrated in 67 sera to determine whether the capacity to increase the agglutination titre of the immune iso-agglutinin was shared equally by all human sera. It was found that the sera varied markedly in their power to amplify the immune agglutinin, and indeed two very active sera were found to increase the titre of the test *Rh* serum from 4 to 256.

The factor present in the serum which causes the increase in titre is not complement as it is not destroyed by heating at 56° C. for half an hour, or by storing the serum frozen solid (— 10° C.) for many months.

The fact that no difference was observed in the titre of naturally occurring antibodies whether titrated in saline or serum indicates that the increase in titre shown by immune agglutinins cannot be ascribed simply to the effect of the viscosity of the serum.

The differentiation of natural and immune agglutinins by their behaviour in agglutination tests suggests that there is a qualitative difference between naturally occurring and immune agglutinins.

In suspected cases of hæmolytic disease of the newborn, the finding of *Rh* agglutinins in the maternal serum strongly supports the clinical diagnosis, but their presence in a serum is often doubtful when the degree of agglutination is very weak. In several instances during the last two years, we have used the agglutination enhancement test and have established beyond doubt the presence of *Rh* agglutinins in such weakly reacting sera. Also, in cases suspected of having received an incompatible blood transfusion, an anti-*A* or anti-*B* titre in the recipient's serum which is increased by the use of this technique is a strong indication that the antibody has been stimulated by immunization and that blood of an incompatible *A*,*B*,0 group has in fact been given.

A detailed account of the work described in this communication will appear elsewhere.

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B. E. Dodd.
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Sutton.
W. T. J. Morgan.
The Lister Institute of Preventive Medicine,
London, S.W.1. July 11.

Transition of Fibrinogen to Fibrin as a Two-Step Reaction

It has been assumed by Apitz[1] that the transition of fibrinogen to fibrin is not a simple reaction, but takes place in two stages. The primary product should be a soluble substance, less stable than fibrinogen, which he called profibrin. By suitable choice of the composition of the electrolytes of the medium, we succeeded in studying the two phases of the reaction separately; thus we obtained a substance which has a better-founded claim to the name profibrin.

At a *p*H on the acid side of the iso-electric point of fibrinogen, for example, at *p*H 5·1, the addition of thrombin to a solution of fibrinogen does not cause clotting. If now the system is neutralized, say *p*H 6·8, the fibrinogen coagulates, which shows that at the acid reaction it has not been irreversibly damaged.

If the neutralization is not carried out immediately, but after a longer reaction at *p*H 5·1, then the clotting-time after neutralization is the shorter the longer fibrinogen and thrombin have been kept together at the acid *p*H (see table):

Composition of the system: 0·5 cm.^{3} fibrinogen according to Laki*, 20 mgm. per cm.^{3} in 0 9 per cent sodium chloride; 0 5 cm.^{3} *M*/5 potassium dihydrogen phosphate; 0·1 cm.^{3} thrombin. After different times of reaction, neutralization of 0·1 cm.^{3} of the reaction mixture with 0·05 cm.^{3} *M*/5 disodium hydrogen phosphate.

Reaction time:	Clotting time:
10 sec.	6 min.
1 min.	5 ,,
10 ,,	4 min. 30 sec.
30 ,,	3 ,, 30 ,,
60 ,,	2 ,,
90 ,,	40 ,,
120 ,,	15 ,,
300 ,,	10 ,,

* Laki, *Z. physiol. Chem.*, 273, 95 (1942). *Stud. Inst. Med. Chem. Szeged*, 2, 27 (1943).

This shows that the formation of fibrin takes place in two steps; the first step, the primary reaction between fibrinogen and thrombin, also takes pl at *p*H-values on the acid side of the iso-electric po of the former; the polymerization of the prim product to fibrin, however, is possible only th when the fibrinogen is negatively charged.

At *p*H 5·1 the presence of thrombin does cause any physical change of the fibrinogen wh could be considered as an indication that polymer tion was beginning. The viscosity at a very velocity-gradient shows only a slight increase[2].

The second phase of the transition is inhibited neutral salts in such a way that we conclude that polymerization of the primary product to fibrin caused by electrostatic attraction. The first react is not inhibited by electrolytes; its nature is obscure.

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(Prepared for publication:
September, 1944.)
Now at
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Beirut.

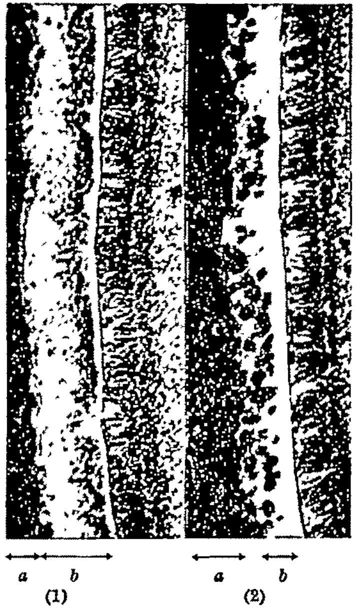
[1] Apitz, *Z. exp. Med.*, 101, 552 (1937).

[2] Pittoni, unpublished results.

Effect of Restriction of Food Intake up the Incisor Teeth of Rachitic Rats

In previous publications[1], it has been shown th the upper incisor teeth of rats are very sensiti indexes of calcium and phosphorus metabolism. Th in rats on the Steenbock and Black rachitogenic d No. 2965[2], doses of vitamin D cause a response whi so far as present work goes, seems to be specific this substance. A line of newly calcified dentin occu in the proximal labial predentin formed after dosag but little change takes place in that already form (Fig. 1). This reaction is accompanied by the usu epiphyseal healing made use of in the line te Changing the Ca : P ratio of the diet given to rachi rats from 5·6 to 1·9 also causes healing in the tee and bones, but quite unlike that after vitamin medication. In the teeth, irregular clumps of cal spherites are laid down promiscuously in the proxim labial predentin. In the bones, an irregular heali occurs in the epiphysis, usually consisting of u growths of calcified material in the metaphysis, jo ing with that in the diaphysis, and often no cl 'line' occurs at all[3].

It appeared to be of interest to compare th changes with those occurring during restriction food intake,, which is well known to cause heali of rickets in rachitic animals. Three litters of r were kept on the Steenbock and Black diet un they had well-marked rickets. Some were then dos with 27 I.U. of vitamin D in oil by mouth and ma tained on the same diet. The rest were also kept the rachitogenic diet, but their food intake was restricted that they lost on an average 3·6 gm. weight per day. Animals treated in either way we killed and examined on the first, second, fourth, six or eighth days after dosage or food restriction. two of the litters the epiphyses of the restricted r showed new calcification on the second day, and the fourth day in the third litter. The changes we quite typical of those seen after vitamin dosage, with lines forming on the metaphyseal s



LONGITUDINAL SECTIONS OF THE PROXIMAL PART OF THE LABIAL SIDE OF THE UPPER INCISOR TEETH. *a* = DENTIN, *b* = PREDENTIN. × 90.

1) Section from a rachitic rat given 27 I.U. of vitamin D four lays previously. The line of new calcification can be seen in the predentin. (2) Section from a rachitic rat the food intake of which was restricted for two days. The irregular masses of calcospherites in the predentin can be seen.

the epiphyseal cartilage, and the two reactions re in fact indistinguishable. The line test became sitive on the fourth day in all animals dosed with tamin D.

The upper incisor teeth of the restricted rats acted within a few hours of dietary restriction. The eth of the animals dosed with vitamin D also acted within a few hours. The changes in the teeth the restricted rats were quite unlike those following vitamin D dosage, but were the same as the anges already described when the Ca : P ratio of e diet was adjusted[3]. In the proximal and intermediate part on the labial side, masses of interobular dentin gradually filled the whole of the prentin, starting from the already calcified dentin and orking, with time, across towards the odontoblasts ig. 2).

The changes in the blood calcium and phosphorus rachitic rats when the Ca : P ratio of the diet is justed are the same as those which occur when ch animals are starved. Kramer, Shear and Siegel[4] ve shown that the blood calcium falls and the osphorus rises in both cases. The animals may have tany, and in the present experiments several of e restricted animals appeared to be on the verge of tany. Thus on chemical grounds, it is easy to plain the resemblance of the reactions in the teeth th both treatments. It is, however, difficult to derstand the differences in the responses in the iphyses, and why the epiphyses of the restricted ts should react in a way identical with that after tamin D dosage when the chemical changes in the ood are so different. One would have expected change similar to that after adjusting the Ca : P tio of the diet.

So far as the teeth are concerned, however, the parative histological changes seen after vitamin D sage or dietary restriction in rachitic rats seem to have quite different mechanisms. Dietary restriction and adjustment of the Ca : P ratio of the diet, on the other hand, produce the same changes.

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May 11.

[1] Irving, J. T., *Nature*, 147, 608 (1941); *J. Physiol.*, 103, 9 (1944).

[2] Steenbock, H., and Black, A., *J. Biol. Chem.*, 64, 263 (1925).

[3] Irving, J. T., in the press.

[4] Kramer, B., Shear, M. J., and Siegel, J., *J. Biol. Chem.*, 91, 271 (1931).

Utilization of the Slipper-Limpet (*Crepidula fornicata*) as Food as an Aid to the Recovery of Oyster-Culture in the Thames Estuary

AN account was given in *Nature*[1] of the very heavy mortality of oysters on certain Thames Estuary oyster beds following and directly attributable to the very severe winter of 1939–40. The financial loss was of a crippling nature, and attention was directed at the time to the need of oyster farmers for financial assistance from the Government for the recovery and restocking of the beds.

During the War, oyster cultivators have had to surrender most of their man-power, with the result that culture has been limited to certain parts of the oyster beds. In these circumstances, as I have found in a recent survey, the American slipper-limpet (*Crepidula fornicata*) has increased on the unworked beds in such numbers as to make dredging for oysters uneconomical while at the same time the total stocks of oysters have remained low. Thus there is greater need for assistance now than in the early years of the War, and in the first place for the cleaning-up of the grounds.

It is now suggested that a practical scheme to help towards the recovery of the oyster-beds is to utilize the slipper-limpet as food and thereby at least partially defray the costs of clearing the grounds. During the War, Korringa[2] has described how the slipper-limpet—which had invaded and spread rapidly on the Dutch oyster-beds since 1929 [3] as foreshadowed by me—became economically valuable as food, being either eaten raw or used in the manufacture of food products. The scale of the slipper-limpet utilization has increased enormously (4,500,000 kilograms were used in 1941 and 14½ million kilograms in 1942). In the early period slipper-limpet meats were separated manually; but later, mechanical devices were used with a great saving in man-power costs (letter from P. Korringa).

While the slipper-limpet, either cooked or raw, makes little appeal to the English palate, it seems possible that during the existing shortage of food-materials in Europe the flesh should have a reasonably high value at the present time when suitably worked up as meat product. Such a product was actually produced by a German firm which, however, kept the process secret; but this is not a serious hurdle.

The practical aspect of the problem is that it will exist only for a relatively short period. Although many hundreds of tons of slipper-limpets could be dredged, the supply would sooner or later fall below an economic minimum, though in this period the beds would be cleared. Hence the problem is essentially one for assistance as a post-war measure.

It is estimated from Korringa's data that dried protein constitutes about 1 per cent of the net weight of slipper-limpets, and as thirty tons of limpets could easily be dredged in a day with appropriate gear, a considerable daily quantity of food-material could be produced; the rate of supply could be adjusted within wide limits to meet the requirements of the manufacturing process.

The object of this communication is to direct the attention of the various bodies likely to be interested to the problem with the view of facilitating early action. These bodies are: Ministry of Agriculture and Fisheries as representatives of public oyster beds, and oyster cultivators; Ministry of Food, representing untapped sources of food supply; Department of Scientific and Industrial Research, as concerned in processes of food manufacture; Development Commission, as the body interested in researches dealing with improvements in fisheries; as well as private manufacturers of food products, and representatives of the oyster cultivators whose beds require clearing.

It is obvious that if these limpets could be used as food there would result the double advantage of contributing to the food stocks of Europe and helping the oyster farmers to clear their beds of this pestilent but extremely interesting immigrant from America.

I am indebted to Dr. P. Korringa for recent information relating to the Dutch oyster beds.

J. H. ORTON.

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Sept. 1.

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[1] *Nature*, 145, 708 (1940)
[2] Visscher: en Meded: Rijksinst. Visscher. Ond. (August 1941).
[3] *Tijdschrift van de Neder*: *Mala*: *Ver*: 7, Nos. 1 and 2, 12 (1942).

The Anti-Chromatic Reflex

IT has long been a matter for surprise that the eye appears to be so perfectly achromatized. It was this which led Euler to conclude that the construction of achromatic lenses must be possible, and in consequence the optician Dollond sought for a method, and thus invented the use of negative flint lenses in association with positive crown glass ones. The celebrated cobalt-blue glass experiment and many others amply demonstrate the fact that the lens system of the eye is uncorrected for colour. It was this fact that presumably led to the remark, which is often ascribed to Helmholtz, that if a lens maker turned out so inferior a lens as that of the eye he would soon be out of business.

Actually the performance of the eye as used in normal vision is of a very high order. Achromatizing the eye by means of a suitable combination of crown and flint glasses improves visual acuity to a very slight extent only. The same is true when monochromatic light, for example sodium light, is used for visual purposes. Further, the resolving power of the eye is only slightly inferior to that of an apochromatic microscopic objective of the same focal length and aperture. But in one important respect the lens system of the eye is greatly superior to such a microscopic objective, namely, in its angle of view, for this in the case of the eye exceeds 100° from the optic axis.

Many explanations have been offered in the p
for the absence of coloured fringes from the reti
image. But none of these has proved to be sa
factory. The experiments which I have repor
previously, in which micro-stimuli have been
ployed[1,2], have now led to the discovery of a nerv
reflex which has the effect of eliminating the colou
fringes produced by the chromatic aberration of
eye. Because of this effect, it has been called '
anti-chromatic reflex'. This reflex consists of
apparently separate mechanisms, one for dealing w
the yellow fringe, and the other for dealing with
blue one; these are the colours of the fringes no
ally present in the emmetropic eye. In the un
rected myope the fringes may be red and blue-gre
and in the uncorrected hypermetrope they may
green and purple, or even blue-green and red.
these conditions the anti-chromatic reflex will pr
ably fail to eliminate the fringes, so that they
be visible to the observer.

The mode of operation of the reflex may be
plained by taking an example. Suppose the obj
looked at to be a white dot on a black backgrou
then the image formed on the retina, owing to
chromatic aberration of the lens system of the e
will consist of a bright yellow dot surrounded by
blue halo of low intensity. The anti-chroma
reflex will now convert the yellow dot into a wh
one, and at the same time the blue halo will
replaced by black; thus the original appearance
the object will be restored.

It is hoped to publish further details of this ref
shortly.

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Aug. 1.

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[1] Hartridge, H., *Nature*, 155, 391 (1945).
[2] Hartridge, H., *Nature*, 155, 657 (1945).

Early Observation of Antibiotic Actio

IN his book "Essays on the Floating-Matter of t
Air" (1881), the physicist John Tyndall descri
experiments which he carried out in 1875 refuting t
doctrine of spontaneous generation of life. In t
course of these experiments tubes of organic infusi
were infected with organisms after exposure to t
atmosphere. A number of cases occurred when su
tubes, which were turbid and swarming with bacter
became covered with *Penicillium glaucum*, three
specified kinds being noticed. The bacteria in the
tubes lost their translatory power and fell to t
bottom, leaving the liquid between them and t
superficial layer clear. Tyndall ascribes this to t
success of the moulds in the struggle for existence a
notes that access of oxygen to the body of fluid m
have been hindered. He did not, however, test t
clear liquid for its capacity to support newly implant
bacterial life. It is interesting to speculate up
what the consequences might have been had Tynd
allowed himself to be drawn from his main investi
tion.

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ATIONALIZATION OF MINERAL RIGHTS

July 1944 the Institution of Mining and Metal-urgy discussed a paper by Prof. W. R. Jones in ch he advocated the acquisition by the State of eral rights. On that occasion he restricted his posals to minerals as contrasted with *rocks* and so not include roadstones, building stones, limestone, k clays, sands and gravels. In a later paper mitted for discussion in September of this year, has extended his advocacy of nationalization to larger group.

t is noted that Great Britain is almost unique in British Empire in that the mineral rights are not ted in the Crown or in the Government. Two ortant steps have already been taken towards ionalization. Under the Petroleum Production of 1934 the ownership of petroleum occurring in tain is vested in the Crown ; under the Coal Act 1938 the State purchased the mineral rights in l by compensating the royalty owners on a basis a fifteen-year purchase of royalties. In addition, as long been accepted that the royal metals, gold l silver, and also any minerals lying under tidal erritorial waters, belong to the Crown. Prof. Jones v advocates the acquisition of all mineral rights the same basis as that used in the case of coal. is careful to point out that State acquisition of eral rights has nothing to do with nationalization mines.

n the earlier paper Prof. Jones deals mainly with d-zinc, tin and china clay. In the case of lead-zinc, s urged that low-grade ores remain to be worked, ich it is in the national interest to use but which mot be done except under a large co-ordinated eme involving drainage and centralized smelting. the case of tin he deduces from the now well-known enomena that copper lodes give place in depth to lodes with a relatively barren zone separating two, that rich tin deposits may underly many abandoned copper mines in the south-west of gland ; but that the problem is a national one ich could be tackled only after the acquisition of mineral rights.

n the second paper Prof. Jones mentions, though does not perhaps stress sufficiently, the profligate ste of land now resulting annually from the working gravel, sand, iron ore and other surface minerals. The most startling feature of the papers is the atively small cost involved. The figure for all se-metal minerals is only £421,000 ; for iron ore than £4,000,000, and for all the minerals of itain less than £22,000,000.

f the policy is regarded as right for coal and oil, seems difficult to resist the conclusion that it is ht for other minerals, but it would seem that of. Jones has only considered part of the problem. e State acquisition of petroleum rights was made *ore*, and in intelligent anticipation of, the discovery petroleum in quantity ; and no land owner could thfully feel himself unjustly deprived of his htful possessions since he did not know such sted. Prof. Jones's proposals deal with acquisition the State of other mineral rights by payment to ners in known mineral-bearing areas. It is here t a link with the general trend of policy regarding d planning suggests itself. If the State were to quire all development rights in undeveloped land at is, on land which is at present agricultural or afforested or open) and thus effectively control surface development, these rights would obviously include any development of minerals. Quite clearly this would solve the pressing problems arising from surface working of coal, iron ore, gravel, sand, limestone and clay, where so much valuable agricultural land is being wasted through absence of adequate provision for restoration. It would permit the control, in the national interests, of the location of mineral workings of all types and open the way for the much-needed balanced planning of the use of the land of Britain.

L. Dudley Stamp.

THE ROYAL STATISTICAL SOCIETY

INDUSTRIAL AND AGRICULTURAL RESEARCH SECTION

The Council of the Royal Statistical Society has decided that the Industrial and Agricultural Research Section, the activities of which were suspended at the outbreak of war, shall be reconstituted in the form of two separate sections—a Research Section and an Industrial Application Section.

From its inception in 1933, the Industrial and Agricultural Research Section met the needs of the growing number of workers interested in applying statistical methods to industry and agriculture. It held regular meetings at which papers were read and discussed, and published the Supplement to the *Journal of the Royal Statistical Society*, which not only contained these papers with reports of the discussions, but also provided a medium for the publication of new developments in the field of applied statistics.

During the War, statistical methods were applied on a greatly increased scale ; in particular the need became apparent in industry for a common meeting ground where the experiences and difficulties arising in the practical application of statistical techniques could be discussed. On the initiative of Dr. B. P. Dudding, an informal Industrial Applications Group was formed in London to fulfil this need, and it was clear from the success attending the activities of the Group that there existed a considerable body of people who, though not necessarily professional statisticians or scientific workers, were very much interested in the practical aspects of the application of these new techniques to industry.

The Council of the Royal Statistical Society feels that the two distinct needs which are now evident will be catered for more adequately by the reorganization which has been effected. The Research Section will be concerned with the theory of statistics and statistical methods and with the development of new applications, while the Industrial Applications Section covers the practical application of statistical technique to industrial research, development, and manufacture, including inspection.

The Research Section, which will meet in London, proposes to hold four meetings during the coming session. Papers read at these meetings will be published in the Supplement to the Society's *Journal*, together with reports of the discussions. Details of the meetings will be announced in *Nature* and other appropriate journals. Visitors who are not members of the Section will be welcome.

The Industrial Applications Section is organized in local groups. In London, Birmingham and Sheffield, groups are already in existence, and the formation of groups at a number of other centres is under consideration. Discussions at group meetings will not in general be published, but should the local group committee consider certain papers to be of sufficient importance, their publication and method of distribution will be considered. Meetings of the groups will be announced in the appropriate journals.

The Supplement to the Society's *Journal* is edited by the Committee of the Research Section under direction from the Council of the Society. It is hoped that, in addition to publishing papers read before the Research Section, it will become a medium for the publication of research work on topics of general interest to statisticians. Such papers need not necessarily be theoretical or mathematical but should expound or illustrate some new development in statistical methodology. At present, papers of this nature are often published in journals devoted to special branches of science and not always readily accessible to workers in other fields.

Membership of either or both Sections is open to fellows of the Society free of charge and to non-fellows who are approved by the appropriate Section Committee, on payment of an annual subscription of ten shillings (for each Section). The Supplement to the *Journal* will be published twice yearly. It will be available to fellows of the Society free of charge and to members of the Sections at reduced rates. Further information may be obtained from the Assistant Secretary, Royal Statistical Society, 4 Portugal Street, London, W.C.2.

RESEARCH WORK AT THE MILLPORT MARINE LABORATORY*

THIS series of annual reports recently issued by the Scottish Marine Biological Association, covering as they do the war years 1939–44, are of great interest. Not only has the work been well maintained, but also the new wing, representing a considerable extension of the laboratory buildings, opened in June 1939, has been in general use. The staff, in spite of several members being absent on war service, has been extremely active and, in addition, workers from outside have added to the programme in various ways. This has been chiefly on the economic side, but ecological and faunistic work has still continued.

Dr. Orr's analysis of the various marine organisms with regard to their nutritive value, based on two hundred different species, including molluscs, crustaceans, fishes, cœlenterates, echinoderms and worms, shows that molluscs, crustaceans, fishes and worms are of high food value, echinoderms and cœlenterates low. The results have been tabulated. His more recent work has been chiefly an investigation of seaweeds with special attention to those likely to provide substitutes for Japanese agar. This research, later in collaboration with Dr. S. Marshall and throughout in close touch with representatives of the Ministries of Supply and Health, resulted in a satisfactory agar substitute being found in the red alga, *Gigartina stellatus*, which is now being used on a commercial scale. A survey of algæ is also being carried out.

Dr. S. Marshall, who in the early part of the period was occupied with the life-histories of certain copepods, besides this agar work, is, together with Dr.
and Dr. F. Gross and J. E. G. Raymont, of the Univ
sity of Edinburgh, taking part in an interesting expe
ment in Loch Sween and its small arm Loch Craigl
by fertilizing the water by the addition of nutri
salts and investigating the effect on the growth of
phyto- and zoo-plankton, and of the fish introduc
An account of this was given in *Nature*[1]. Latest repo
show that the added nutrients were rapidly absor
and an increase in the size of the fish was in ma
cases large.

The question as to the value of marine plankton
food for land animals was raised by Sir John Grah
Kerr in 1941, and Prof. A. C. Hardy of Aberde
with the approval of the Agricultural Research Coun
took the matter up and devised experiments in
operation with the Millport Station, primarily to se
plankton could be obtained in sufficient quantities
be used to form an addition to protein meal for anin
stock and poultry. Good samples of *Calanus* m
were prepared, but the results during the three ye
did not yield the hoped-for practical results, althou
Prof. Hardy regards it as a speculative investigat
which was well worth trying as a possible additio
source of protein in war-time.

In 1941, Dr. J. E. Harris, working under the Mar
Corrosion Sub-Committee of the Iron and St
Institute, began his researches at Millport on proble
connected with the marine fouling of metals. T
work has increased considerably and several assista
are now working at the various subjects, including t
colonization of the experimental rafts with plant a
animal growth. Much valuable information has be
obtained in connexion with these researches, t
technical side of which will be published in the repo
of the Marine Corrosion Sub-Committee. On t
biological side, among other points of interest, a
K. A. Pyefinch's work on the barnacle larvæ and I
M. Mare's on the succession of algæ and on the p
played by the bacterial slimes in the development
fouling growth.

Experiments on prawn trawling and on the p
duction of seaweed meal were also made, and besid
the work of direct economic importance ecologi
studies have continued, especially in Kames Bay,
Dr. A. C. Stephen and others, including the mollusc
and crustacean fauna, the microfauna of the intertic
sands, and insect larvæ of the shore.

The food of the shag was investigated by A.
Hadow and W. H. R. Lumby, who show close agre
ment with Steven's[2] observations, the bird being
little economic importance.

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* Annual Reports of the Scottish Marine Biological Association (1938–39, 39–40, 40–41, 41–42, 42–43, 43–44). (185 St. Vincent Street, Glasgow.)

[1] *Nature*, 153, 483 (1944).

[2] *J. Mar. Biol. Assoc.*, 19, 277.

INDIAN PLYWOOD FOR TEA CHESTS

THE long stretch of country situated at the fo
of the eastern Himalaya is occupied by a su
cession of tea gardens which extend up into the out
hills to some 5,000 ft. or so elevation on the we
Since the introduction of the growth of tea into t
region, the necessary tea box or chest for packi
and exporting the tea has been something of a proble
with a varied history. In the supply of those garde
situated in Assam, saw mills were erected in Assa
many years ago, but most of the chests required ca

as imports from Europe in the form of shooks, tens and metal fittings, put together to form the st on the spot.

his century has witnessed the advent of plywood revolutionized the construction of the tea chests. *Indian Forest Records* (New Series: Utilisation, . 3, No. 4, Forest Research Institute, Dehra Dun, 5), Mr. V. D. Limaye deals with "The Testing of ian Plywood Tea Chests" with the object of estab- ing a standard type. With this objective in view, e different types of plywood tea chests were sub- ted to systematic scientific tests at the Timber ting Laboratory, with the view of establishing a ndard tea chest of Indian make, comparable with best of foreign makes. In India, plywood tea sts are manufactured from various timbers such hollock (*Terminalia myriocarpa*), hollong (*Diptero- pus macrocarpus*), mango (*Mangifera indica*), ul (*Bombax malabaricum*), pali, and others. llock is the main source of supply. It grows in forests of Assam.

n the past, boxes of all these timbers have been jected to systematic research at Dehra Dun. The ies of exhaustive tests here described was carried on nine different types of tea chests, known as 'O', 'S' and 'M' types made chiefly of hollock ber with the view of analysing their comparative rits, and establishing a standard type of Indian wood tea chest comparable with the best foreign kes. It would appear that this object has been filled and that in this respect India at last can be nsidered as no longer dependent on imports. Boxes each of the nine types, totalling in all 210, and presentative of the average quality produced by e mill, were supplied in shook form by the Assam w Mills. The most common size of box, namely, in. × 19 in. × 24 in., was chosen for the tests. In ch of the 'O' and 'S' types, boxes of sizes 14 in. × in. × 14 in., 16 in. × 16 in. × 16 in., 18 in. × in. × 18 in., 18 in. × 12 in. × 18 in. were tested, e thickness of the veneers varying. In the 'O' type e plywood was all hollock. In the 'S' type the tside ply is of hollong (*Dipterocarpus macrocarpus*). the 'M' type the outer ply is of semul. Boxes de with the side panels with the grain vertical are e strongest.

Summarizing the research work the following sults are given: The 'O', 14 in. × 14 in. × 14 in., d 'S', 14 in. × 14 in. × 14 in., types of plywood -chest are found to be very much stronger than e average of the best five makes of imported birch -chests, taken as the datum for comparison. By ducing the thickness of plywood to 3/16 in., it has en found that the cost of a tea-chest can be reduced, ing to economy in timber, without sacrificing the ength required. 18 in. × 12 in. × 18 in. type and in. × 16 in. × 16 in. type are both comparable to e datum birch tea-chests; but the 18 in. × 12 in. 18 in. type is found to be slightly stronger than e 16 in. × 16 in. × 16 in. type, probably due to a re balanced construction of plywood. The tea- est of 'O', 18 in. × 12 in. × 18 in. type, is, there- re, recommended as a standard, if making veneers two different thicknesses is not considered a great sadvantage from the manufacturer's point of view. 18 in. × 12 in. × 18 in. type is not considered nvenient, then 16 in. × 16 in. × 16 in. type, which the next best, can be established as the standard. ere is no difference of any practical importance tween the 'O' and 'S' types so far as strength is ncerned.

JOHN INNES HORTICULTURAL INSTITUTION

THERE is nothing merely formal or perfunctory, and much that is challenging, in the thirty-fifth annual report, for 1944, of the John Innes Horticultural Institution (from the Institution, Mostyn Road, Merton Park, London, S.W.19. 1945). Dr. C. D. Darlington, director of the Institution, has recently enunciated the hypothesis that "viruses of specific types can be created by grafting particular pairs of individuals". This is based on M. B. Crane's experiments on grafting the apple variety, Lord Lambourne, with other varieties. Lambourne may then become infected with two abnormalities—'rubbery wood' and 'chat fruit'—deemed to be viruses. From the evidence presented in the report, it would seem that such infection could be explained by the assumption that Lambourne is completely susceptible to the two viruses, for which most apple varieties are symptomless carriers. The assumption that viruses are 'created' by the graft union seems at least a little ahead of the facts.

Mr. Crane and Dr. Lewis make the interesting suggestion of raising hybrid raspberries from seed, in order to eliminate virus from the initial stock. Preliminary experiments show satisfactory yields from hybrids, but many facets of the problem require consideration before hybrid seedling production can be regarded as a commercial proposition.

Dr. P. T. Thomas has found that 'bolters' in the potato crop possess an extra chromosome fragment which may presumably account for their premature flowering. Statistical technique has been applied by Dr. K. Mather to the analysis of behaviour and organization of polygenes. This provides more exact equipment for the plant breeder; and makes it possible to predict minimal selective limits, to relate the actual number of genes to their observed expression, and to determine whether hybrid vigour has reached the maximum.

The Institution has adopted the title, "Answers to Growers", for its first *Bulletin* (price 2*s*. 6*d*. from the Institution). Growers appear to have left the Institution in no doubt of their needs and, if their questions are such as to epitomize the work of the John Innes at present, that selection only allows of more factual and experimental answers. The grower is told that hoeing is of value for weed control rather than for moisture conservation; that composting tomato haulms does not destroy any virus they may carry; that the ultimate behaviour of his plants depends a good deal upon the character of the compost used for raising seedlings. Questions about the practical culture of sweet corn are answered. The particular and complex methods of hybrid seed production of this crop by top-crosses, double- and three-way crosses, and by synthetic varieties, are explained. The question, 'What are the best plums to grow?', is answered by stating general principles—correct interplanting of dessert kinds (which are self- and cross-incompatible), the separation of high-nectar varieties from those with low nectar, and the choice of frost-free sites, as plums flower early in the season. Some varieties of apple are shown to resist attack by red spider.

The *Bulletin* has achieved the right practical tone; it is well produced, with a general series of photographs of experiments at the Institute, and the identity of the contributors is but thinly veiled by their initials.

FORTHCOMING EVENTS

Monday, December 3

Royal Society of Arts (at John Adam Street, Adelphi, London, W.C 2), at 1.45 p.m —Dr. F. C. Bawden : "Virus Diseases of Plants", 3. "The Nature of Viruses" (Cantor Lectures).

Farmers' Club (at the Royal Empire Society, Craven Street, Strand, London, W C 2), at 2 30 p m —One Hundred and Third Annual Meeting. Dr. S. J. Wright : "The Next Phase in Agricultural Mechanisation".

Society of Engineers (at the Geological Society, Burlington House, Piccadilly, London, W 1), at 5 p.m.—Dr H. G. Taylor : "Earthing" (illustrated by Film and Lantern Slides)

Society of Chemical Industry (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 6.15 p.m.—Mr. W. G Atkins : "Jute and the Chemical Industry" ; Dr. A. J. Turner : "The Properties and Uses of Flax".

Tuesday, December 4

British Society of International Bibliography (at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment; London, W.C.2), at 2.30 p.m.—Dr. R. T. W. Reynolds and Mr. W. A. Silvester : "Plastics, their Nomenclature and Classification" ; Mr. A E. Tooke : "The Information Bureau of the Electrical Research Association".

Zoological Society of London (at Regent's Park, London, N.W.8), at 5 p.m.—Scientific Papers

Royal Institution (at 21 Albemarle Street, London, W.1), at 5 15 p.m —Sir Henry Dale, O.M , Pres.R.S. : "Recent Developments in Chemical Therapeutics", (i) "The Beginning—Dyes, Arsenicals, Antimonials, etc.".

Royal Statistical Society, Research Section (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 5.15 p m —Mr. G. A. Barnard . "Sequential Tests in Industrial Statistics".

Royal Anthropological Institute (at 21 Bedford Square, London, W C.1), at 5.30 p.m.—Rev. H. St. John Evans : "Anthropology and the Missionary".

Wednesday, December 5

Royal Society of Arts (at John Adam Street, Adelphi, London. W.C 2), at 1.45 p m.—Dr. C. F. Goodeve, F.R S. : "The Defeat of the Magnetic Mine".

Geological Society of London (at Burlington House, Piccadilly, London, W.1), at 5 p.m.—Dr. Leslie Rowsell Moore · "On the Spores of some Carboniferous Plants".

Institution of Electrical Engineers, Radio Section (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. F. C. McLean and Mr. F. D. Bolt : "The Design of Radio-Frequency Transmission Lines and Switchgear for Medium-Wave and Short-Wave Broadcasting Systems".

Society of Chemical Industry (Joint meeting of the Food Group with the Society of Public Analysts and other Analytical Chemists, at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 6 15 p.m.—"New Routine Tests and their Application in Modern Food Industry". (1) Dr. A. J. Amos . "New Routine Tests in examining Wheaten Products" ; (2) Dr. H. G. Davis : "New Routine Tests in the Dairy Industry" ; (3) Dr. F H. Banfield and Mr. J. C. Morpeth . "Some Newer Methods of determining Meat in Meat Products" ; (4) Mr. D. W. Grover : "Physical and Chemical Methods for Moisture Determination".

Society for Visiting Scientists (at 5 Old Burlington Street, London, W.1), at 7 30 p.m.—Discussion on "Science in India and the Colonies" (Speakers : Dr. S. Siddiqui, Dr. J. L. Simonsen, F.R S., Dr. E. B. Worthington and Major-General Sir John Taylor, C.I.E.).

Thursday, December 6

Manchester Joint Research Council (in the Whitworth Hall, The University, Manchester), at 11.30 a.m —Sir John Anderson, G.C.B. : "Research in relation to Reconstruction".

Physical Society (in the Lecture Theatre, Science Museum, Exhibition Road, London, S.W.7), at 5 p.m.—Dr. John A. Fleming : "Geomagnetic Secular Variations and Surveys" (Third Charles Chree Address). (Fellows of the Royal Astronomical Society and the Royal Meteorological Society are cordially invited.)

Royal Institution (at 21 Albemarle Street, London, W.1), at 5 15 p.m.—Sir James Jeans, O.M , F.R S. : "Physical Astronomy", (ii) "The Hot Matter of the Stars".

Institution of Electrical Engineers (at Savoy Place, Victoria Embankment, London, W.C.2), at 5 30 p.m.—Mr. R. H. Coates and Mr. B. C. Pyle · "The Operation of Large Turbo-Alternators to reduce Rotor-Winding Deformation".

Society of Chemical Industry (joint meeting of the Bristol Section of the Chemical Engineering Group and the Institution of Chemical Engineers, in the University Chemical Department, Woodland Road, Bristol), at 5.30 p.m —Mr. Stanley Robson : "Chemistry, Metallurgy and Empire" (First Robert Horne Memorial Lecture).

British Psychological Society (at Bedford College, Regent's Park, London, N.W.1), at 7.30 p.m.—Mr. W R. Bion : "Some Basic Considerations in the Dynamics of the Group" ; Mr. J. D. Sutherland : "Some Sociatric Lessons from Officer Selection".

Friday, December 7

Royal Institution (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Air Commodore F. Whittle . "The Advent of the Aircraft Gas Turbine".

Geologists' Association (at the Geological Society of London, Burlington House, Piccadilly, London, W.1), at 6 p.m.—Dr. A. J. Bull : "Terrestrial Heat and Earth Movements".

Saturday, December 8

Biochemical Society (in the Bearsted Theatre, London Hospl Whitechapel Road, London, E.1), at 2 15 p.m.—Scientific Papers Demonstrations.

Friday, December 7—Saturday, December 8

British Association for the Advancement of Science, Divis for the Social and International Relations of Science (at London School of Hygiene and Tropical Medicine, Keppel Str London, W.C 1).—Conference on "Scientific Research and Indust Planning".

Friday, December 7

At 10.15 a.m.—"Fundamental Research in relation to the Co munity" (Speakers : Dr. M. Polanyi, F.R.S , Prof J. W. Mun Prof. C. D. Ellis, F R.S., Prof. A. G. Tansley, F.R.S., Dr. C. D. Darli ton, F.R.S.).

At 2.15 p m —"Planned Research". (Speakers : Sir Edw Appleton, K.C.B., F.R.S., Dr. C. F. Goodeve, F.R.S., Dr. E. Armstrong, F.R.S., Sir William Larke, K.B.E , Dr. P. Dunsheat

Saturday, December 8

At 10 15 a.m.—"Economic Aspects of Research" (Speakers : P P. Sargant Florence, Mr. F. E. Smith, Prof. M. L. E. Oliphant, F.R.

At 2.15 p.m.—"The Human Factor". (Speakers : Sir Art Fleming, Dr. C. P. Snow, Mr. J. Kendall, Prof. J. D. Bernal, F.R. Mr. J. A Lauwerys.)

APPOINTMENTS VACANT

Applications are invited for the following appointments on before the dates mentioned :

Assistant Agricultural Organizer to the Holland Cour Council—The Principal, Agricultural Institute and Experimen Station, Kirton, Boston, Lincs. (December 8).

Assistant Advisory Officer in Market Gardening to the Ke Education Committee—The County Agricultural Organizer, Brunswi House, Buckland Hill, Maidstone (December 8).

Chief Engineer and Manager to take charge of operations Electricity Supply Division of Department of Industries and Labo Government of Burma—The Ministry of Labour and National Servi Appointments Department, Technical and Scientific Register, Roo 670, York House, Kingsway, London, W.C.2, quoting D.1555. (December 10).

Lecturer in Biology (Honours Graduate, with Physiology subsidiary subject)—The Clerk to the Governors, South-East Ess Technical College and School of Art, Longbridge Road, Dagenha (December 10).

Production Chemist (Degree standard, with experience in sup vision of manufacture and packing of food or domestic products) large manufacturing firm (household products) in West London- The Ministry of Labour and National Service, Appointments Depa ment, Technical and Scientific Register, Room 670, York Hous Kingsway, London, W.C.2, quoting F.5123 XA (December 11).

Mechanical Engineer (University degree or A.M.I Mech.E. equivalent, with practical training and experience in design of sen heavy engineering plant, preferably hydraulic and oil-field equipmen by old-established contracting and manufacturing company in Lond area—The Ministry of Labour and National Service, Appointmen Department, Technical and Scientific Register, Room 670, York Hous Kingsway, London, W.C.2, quoting C.2950.XA (December 11).

Principal of the Peterborough Technical College—The Ch Education Officer, Education Offices, Town Hall, Peterborou (December 15)

Senior Technician in the Department of Biochemistry—Pr H. Raistrick, F.R.S., London School of Hygiene and Tropical Medicin Keppel Street, London, W.C.1 (December 31).

Junior Lecturer in the Biology and Pharmacy Department- The Clerk and Treasurer, Dundee Institute of Art and Technolog Bell Street, Dundee.

Laboratory Assistants—Grade I and Grade II for the Che istry Department, and Grade I for the Physiology Department- The Secretary, King's College of Household and Social Science, Camden Hill Road, London, W.8.

General Secretary—The Hon. Secretaries, Society of Chemi Industry, 56 Victoria Street, London, S.W.1.

Lecturer in Chemistry—The Principal, Leicester College Technology and Commerce, Leicester.

Lecturer (full-time) in Zoology and Biology—The Cle Northern Polytechnic, Holloway Road, London, N.7.

Laboratory Technician (male, Grade B), experienced in Hæmat logy and Biochemistry and in taking specimens of blood from patie —The Secretary, Harrogate and District General Hospital, Harroga

Lecturer in Mathematics in the Canterbury University Colle Christchurch, New Zealand—The Secretary, Universities Bureau the British Empire, c/o University College, Gower Street, Londo W.C.1.

Visiting Lecturer in Psychology (temporary)—The Secreta King's College of Household and Social Science, c/o University Colle Leicester.

Lecturer in Psychology in the University of the Witwatersra Johannesburg—The Secretary, Universities Bureau of the Brit Empire, c/o University College, Gower Street, London, W.C.1.

Graduate Lecturer to teach Biology to at least Intermedi B.Sc. standard—The Principal, Norwich City College and Art Scho St. George Street, Norwich.

Graduate Assistant (full-time) in Biology (to First M.B. a Inter. Pharm. standard), and Physiology and Anatomy for rec nized pre-nursing classes, in the South Devon Technical Colle Torquay—The Education Officer, Lymington Road, Torquay

NATURE

o. 3971 SATURDAY, DECEMBER 8, 1945 Vol. 156

CONTENTS

Page
hnology and Administration . . . 671
logy in the Service of Man. By Sir John Russell, .R.S. 675
ciples of Education. By T. Raymont . . . 676
any in Latin America 676
Mission of Science. By Sir Henry Dale, O.M., i.B.E., F.R.S. 677
Electrical Hypothesis of Synaptic and Neuro-uscular Transmission. By Prof. J. C. Eccles, F.R.S. . 680
ituaries :
  Dr. J. C. Merriam. By Prof. D. M. S. Watson, F.R.S. 683
  Prof. Velyien Henderson. By Prof. J. H. Gaddum, F.R.S. 683
ws and Views 684
ters to the Editors :
  Univalent Electron Transfers in Aromatic Nitration ?—G. A. Benford, C. A. Bunton, E. S. Halberstadt, Dr. E. D. Hughes, Prof. C. K. Ingold, F.R.S., G. J. Minkoff and R. I. Reed, . 688
  Mechanism of the Beckmann Rearrangement.—M. J. S. Dewar 688
  Porphyrin Fluorescence in the Livers of Pellagrins in Relation to Ultra-Violet Light.—Dr. J. Gillman, Dr. T. Gillman and S. Brenner . . . 689
  Acetylphosphatase in Animal Tissues.—B. Shapiro and E. Wertheimer 690
  An Attempt to Obtain Nuclear Excitation by Means of X-Rays.—Sigvard Eklund . . . 690
  Use of Growth-Promoting Substances in the Prevention of Apple Drop following Frost.—T. Swarbrick . . . 691
  Accumulation of Sugars in Barley Seedlings on Very Acid Soil.—T. W. Barnes 692
  Acoustic Control in the Flight of Bats.—Dr. D. W. Ewer ; Prof. H. Hartridge, F.R.S. ; Flight-Sergeant Martin Wilkinson 692
dal Awards of the Royal Society 694
e Research Institute, Calcutta : Annual Reports . 696
ent Chemical Research in the U.S.S.R. 697

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TECHNOLOGY AND ADMINISTRATION

MEMBERS of the present Government have already made several statements of their appreciation of the importance of both scientific and industrial research, and affirmed that the Government is no less determined than its predecessor to encourage and support its prosecution within industry, by the universities and by the Departments of State. That research is an essential factor in industrial efficiency is a lesson well learnt since the Balfour Committee published its series of reports in the decade after the First World War. The need for a great expansion in the nation's research effort is now unchallenged : the questions at issue are rather how best to utilize our available resources of men and material, and to provide the most effective means for expansion.

Research, however, is not the sole factor in industrial efficiency that calls for the fuller and wider use of trained minds. Mr. Herbert Morrison, Lord President of the Council, rightly remarked on November 6, in addressing a conference of industrial research associations, that scientific and technical help will be required on the administrative and production side as well as in research, in order that effective use may be made of the new processes and products which may come from research. This has been followed up by the appointment by the president of the Board of Trade of a committee under the chairmanship of Sir Clive Baillieu, president of the Federation of British Industries, to frame proposals for the formation of a British Institute of Management, to which the Government would contribute financial assistance.

The importance of management has been stressed in many recent reports on scientific and industrial research, such as those coming from the Parliamentary and Scientific Committee, the Association of Scientific Workers, the London Chamber of Commerce and other bodies, and is a main theme of two important reports which have just appeared.

The first of these, "University Education and Business", comes from a committee, under the chairmanship of Sir Will Spens, appointed by the Cambridge University Appointments Board*. This report was the outcome of an inquiry initiated in 1937 to consider how adequately the University of Cambridge was equipping students who intended to use the business world, and whether employers were using as well as possible men trained by the University. Admittedly it is based only on samples, for of three hundred firms to which a letter of inquiry was addressed, only one hundred and fourteen replied ; while, of some seventeen hundred Cambridge graduates known to be in business, only three hundred and twenty-six replied to a similar but differently worded letter. Members of the Committee also collected certain important facts and solicited the opinions of those having special knowledge. Moreover, the inquiry must be recognized as a definite attempt by the Cambridge University Appointments Board to fulfil functions laid down by Dr. C. P. Snow as necessary for university appointments boards, and by the Hankey Committee for the Appointments Department of the Ministry of Labour and National Service. The Committee has clearly done an admirable piece of work, and the report offers a prototype for inquiries which might be undertaken systematically by other university authorities.

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* University Education and Business. Pp. viii+78. (London: Cambridge University Press, 1945.) 2s. 6d. net.

The report opens with the frank recognition of the far-reaching social changes which are taking place in the national life of Britain, and in particular the implications of our changed outlook on education. Educational changes are likely to increase the number of really able men who succeed in obtaining university education at the public expense, so that in the future the number of such men who have not been to a university will be considerably fewer. The process of selection by ability is taking place at all ages and educational levels, and will greatly affect the industrial population. The 'working parties' appointed by Sir Stafford Cripps will not need to probe deeply into the measures required to increase the efficiency of the industries they are investigating to discover the great importance of recruiting the right type of industrial leader. This question is as important from the point of view of eliminating social and industrial friction as of industrial advance. Industry needs minds competent both to appraise the human factors in a situation and quick to appreciate the possibilities of technical innovation. Its leading positions more and more must be filled by men whose minds by habit and training are strategic rather than tactical, who are accustomed to verify ideas and opinions by a study of facts and results, and to take long-term rather than short-term views of costs and advantages.

Apart from this, the gradual raising of the educational standard and cultural outlook of industrial and clerical workers in itself will accentuate the demand for a higher standard of industrial leaders. Business will require an adequate supply of the ablest minds, and since these will in the future be drawn for the most part from the universities, it is important that university education should be such as to fit them for their part, as technicians, as managers or as directors. In regard to one university, the report confirms the widely held opinion that the intellectual level of men entering business is, on the whole, not so high as that of men entering certain other occupations. Only about one third of the men who left Cambridge in 1937 and 1938 went into commerce or industry on the administrative or scientific side; and although only one half of this number of men took up administrative or research posts outside business, this sixth included two thirds of all the Cambridge men who gained first-class honours in those years. Judged by this definition, those entering business included less than one fifth of the 'best brains'. Over the two years, only the Forces had a lower percentage than business, excluding its scientific side, among their entry.

The report considers in detail some of the factors affecting the recruitment of university men for business and their employment when recruited, and in this the opinions of both employers and graduat were very helpful. The latter were more critical, b the former were for the most part very full and ca fully thought out, sometimes the result of conferenc of executives. Both sets of replies showed clea that the university man has an important part play in the business world, and endorse the t fundamental assumptions which underlie the repor first, industry, in its widest sense, plays a mo important part in the social life of a modern co munity; and secondly, business provides an opp tunity for the highest form of social service for ma of the ablest people in the country.

The report rightly points out that universi residence as such is not necessarily an advantage business; it is only an advantage to the man who able to assimilate what is offered at the universi and to benefit from it. Some undergraduates wou undoubtedly make better use of their time at t university if their minds were more mature and h been fortified by some experience of practical li University education, the Committee suggests, probably of most use to those who are sufficient mature to have a sense of values, but not so matu as to find difficulty in appreciating new values; a what the Committee has to say on this question the type of university man wanted in business has profound bearing on the absorption into industry a commerce of men and women released from t Forces whose attainments and character qualify the for employment which would lead to administrati and executive posts.

The observations of the Cambridge Committ appear to be more fundamental than those to found in the report on Training for Business A ministration made by the committee appointed by t Minister of Labour and National Service last Februa under Sir Frank Newsom-Smith as chairman to co sider the latter problem and to make recommend tions for suitable courses of training. That report not concerned with men who may wish to acqu professional qualifications, as for example in accou ancy or law, as a preliminary to entering the busin world, and it also excludes those who may wish graduate or take a postgraduate course in busin administration, and for the same reason—th educational facilities and, if necessary, financ assistance are already available for both these class While this Committee may well be right in co sidering that the ex-Service men with whom they a concerned will want to obtain employment as quic as possible after their release from the Forces, it difficult to avoid the conclusion that the Commit has taken a narrow and short-term view of t problem, and that the long-term and national po of view has received insufficient attention.

The problem was considered almost entirely from t point of view of the ex-Service man and the employ and for the most part the Committee's recommen tions for provision of a course of basic general traini in business administration lasting about three mont full-time, or longer part-time, and given at techni and commercial colleges before or after engagem by an employer, with financial assistance availa der the Further Education and Training Scheme, e of passing, rather than permanent, importance.

The main exception to this is a suggestion, falling yond the Committee's terms of reference, for an terdepartmental committee of representatives of e Ministry of Labour and National Service and the ducation and Service Departments to supervise the rangements and co-ordinate schemes of post-release aining with training given while men are still in the rvices. Such a committee could usefully supplement the work which it is proposed the university pointments boards or the Appointments Department of the Ministry of Labour should do, and may ell assist in the education of industry and business this matter.

If business is to attract a sufficient proportion of e ablest men to ensure that wise leadership is always ailable, it will find itself in competition with other cupations, and the report of the Cambridge ppointments Board accordingly considers the use ade of the university men in business. Probably e strongest incentive determining choice of occupaon is a desire for responsibility. If a man has a ceptive mind and has lived for three years in an mosphere of ideas in close contact with men whose unction is to stimulate them, he will be anxious find an occupation providing an opportunity for e exercise of ideas. If he has not, he will be e type of graduate that employers are agreed ey do not want. Able graduates should not therere be recruited by firms unless there are obvious ositions of responsibility to which they can reasonbly look forward in the not too distant future.

The report makes the important point that the aining given to university men in business should e adapted to their stage of mental development, hich obviously differs from that of the schoolboy ntering business. Again, those being trained for anagement should know something of the special kills in each department of a firm and their relative ifficulty, and they should know a good deal about e interaction of departments ; and special stress is id upon the value of sympathetic sponsorship of an ppropriate senior member of the staff in helping the oung graduate to appreciate the purpose and method f his training, stimulate or curb ardour as occasion quires, and ensure that he gets a fair deal at the ands of executives under whom he will be working uring his tour of departments. Such handling will lso encourage that feeling of loyalty which firms ten say is one of the best features of university men business, and which is one of the most valuable fts a man can offer to an institution.

The Cambridge report also urges that a larger oportion of the higher administrative posts should e held by men with a scientific training, particularly manufacturing firms. It challenges the fundaental snobbery running through the whole social stem of Britain, which tends to regard those who al with organization and finance as superior to ose who deal with research and production ; and its assertion that the only way to make science operly available in the public service and business to insist that the technical expert be equal in status and pay to the non-technical administrator in every grade of promotion, the report is in line with the recommendations of the Barlow Committee on Scientific Staffs in Government Departments.

On the side of the University, the report makes a number of suggestions for strengthening its links with the world of business and industry and for improving the preparation of the graduate for that world ; these suggestions include the strengthening of the Appointments Board and the content of courses. All these observations, like those on the value of business experience before or during a university course, deserve the attention of other universities and appointment departments. Moreover, the whole report abounds in observations which are suggestive of ways and means by which firms could do much to eliminate the present weaknesses, and above all that tendency to regard technical posts as blind-alley occupations unless they lead to administrative posts in technical firms.

Another report recently issued is that of the Special Committee appointed, in April 1944 under Lord Eustace Percy as chairman, by the Minister of Education, Mr. R. A. Butler, to advise on the needs of higher technological education in England and Wales, with particular reference to the means for maintaining co-operation between universities and technical colleges (London : H.M. Stationery Office. 6*d*. net). The Committee's inquiries convinced it of the need for a standing organization, both to survey industry and to co-ordinate education. The evidence submitted concurred in the general view that the position of Great Britain as a leading industrial nation is being endangered by a failure to secure the fullest possible application of science to industry, and that this failure is partly due to deficiencies in education. In particular, the experience of war has shown that the greatest deficiency in British industry is the shortage of scientific men and technologists who can also administer and organize, and can apply the results of research to development. While recognizing that both educational institutions and industry may not have handled their material to the best advantage, the Committee concludes that industry and educational institutions training for industry are not getting their fair share of the national ability.

The Committee's suggestions for a campaign to increase the prestige of the technical professions and to arrest some of the present leakage of good brains from secondary schools at the age of sixteen include a continuance of the special State bursary system, both for universities and for technical colleges, with improved methods of selection, and the extension of the benefits of this system to candidates from industry as well as from secondary schools. It is urged that the whole question of scholarships for students of technology needs thorough reconsideration. Like the Nuffield College statement, the report challenges the adequacy and the dominance of evening classes for higher studies so exacting as those demanded of the modern engineer ; and in raising the whole question of adjustment between technical college and university courses, as parts of one coherent system of higher technical education, the report touches also on the question of the movement of postgraduate students, and the coherent planning of technological research in Britain, or rather of the institutions where it can be prosecuted with adequate facilities and resources.

The main outcome of this report is a scheme for the co-ordination of higher technological education by a National Council of Technology and a series of regional advisory councils throughout England and Wales; but one looks in vain for any clear conception of the relative functions of the universities and technical colleges. In spite of the emphasis laid on quality, there is little attention paid to the vital importance of research. Quantitatively, the Committee has only attempted to define the needs in respect of mechanical, electrical and civil engineering, and its pre-occupation with engineering may be partly responsible for the proposal, on what might appear inadequate grounds, for the selection of a strictly limited number of technical colleges—for engineering, up to six is suggested—in which there should be developed technological courses of a standard comparable with that of university degree courses.

The need for further co-ordination of the work of the technical colleges and the universities of Britain has been emphasized in other reports, and the Committee's proposals go some way to meet these criticisms that the existing provision for advanced technical education lacks form and system. The regional advisory councils it proposes would be concerned with the co-ordination of technological studies in universities, colleges of technology and other technical colleges of the region. As an essential part of the regional machinery it suggests also regional academic boards of technology, composed of the academic heads of universities and technical colleges and of members of their teaching staffs, and the consultation with industry which is an essential purpose of the whole regional organization should be conducted largely through this agency.

The regional machinery would have its national counterpart in a National Council of Technology at least partly representative of regional advisory councils and of the regional academic boards, but appointed by the Minister of Education at his discretion. This body would be responsible for considering the national aspects of regional policies, and for advising the Minister and the University Grants Committee; but no change is suggested in the administrative responsibilities of these two central authorities, nor any restriction of their freedom of communication with local education authorities and universities and with the regional bodies. The constitution of the regional academic boards is outlined in more detail, and it is to these boards that the Committee believes that the country must mainly look for advice on the steps necessary to meet the demand of industry for quality.

These proposals obviously should help to provide industry with more of the technical leaders it requires, though their bearing on the all-important question of quality is less apparent. The report estimates the requirements of the engineering industries for senior administrators, engineer scientific workers and development engineers and engineer managers at abo 3,000 each year, of whom upwards of half must drawn from the technical colleges, the limit of t output of the universities and university colleges England and Wales being put at 1,200. But it for some 350 of the trained engineers coming fro the technical colleges that the Committee propos to develop the special colleges and courses alread noted.

Two concluding recommendations of the Committee are, however, of more interest to this questio of providing industry with the quality of leadersh it requires. First, in regard to management studie the report recognizes that this body of knowledge ca be taught only by those who have a thorough practic and theoretical grasp of it, and comments on t poor quality of the present literature of the subje in Britain and the absence of the intellectual conte of a sound mental discipline. The report accordingl recommends that all students of technology, wheth at universities or colleges of technology, should introduced to these subjects during the final year two of their undergraduate course. It also recommends that at least one institution should be select as a centre for postgraduate study of industri administration. It should be the function of th centre to set standards in the teaching of the subje to systematize it as a mental discipline, to condu the necessary research, to develop the literature the subject and to train teachers for it. The repo also recommends that management studies shoul form a part of the courses of all technical colleg teaching for the national certificates and diplom and should form the subject of short or refresh courses organized jointly by teaching institutio and industry.

The second matter relates to the special needs teachers of technological subjects in universities an technical colleges. The only really satisfactory wa for such teachers to keep up to date in the industri technique of their particular subject is for the teach to return to industry for substantial periods. This a matter which might well be dealt with by t regional academic boards in collaboration with t industries in the region, while the National Coun of Technology might arrange for exchanges wi teaching institutions abroad. Something might a be done for teachers in the way of refresher cours of an academic character, while industry should prepared to release senior members of staff to gi advanced courses of lectures during the day. B the most effective remedy will probably be found the upward adjustment of the salary scales teachers and lecturers in the technical colleges a universities.

The first of these matters is clearly related to t proposals for an Administrative Staff College a nounced almost simultaneously with the publicati of the Percy Report. This new venture, initiat with the support of individuals and groups fro industry, local government, education, commerce a distribution—but not, seemingly, the Civil Service is intended to bring together able young men a women who have already mastered the arts ganization in their own departments, in a more tensive study of the science of administration in its ider applications. The College is not to be conrned with preliminary training, but is rather an periment which, if it is to succeed, must provide a eeting place of the administrative officers of both e public and the private services. It is a staff llege and not a training college, and is intended to e and to do something quite different from any ventual Civil Service college. Indeed its most aluable function may be to promote the closer nderstanding by the two types of administrators of ch other's problems.

In future, as in war-time, the industrial and the ublic administrator must work increasingly together, nd if friction and frustration are to be avoided in hatever changes may take place in the structure nd organization of industry, the public services or he machinery of Government, these two types of dministrator must understand the very different tuations in which they are placed and the different esponsibilities which they carry. The success of the enture will be judged by the measure in which it ssues in better practice directed to the fuller service f the public interest—the same criteria by which the uccess of that other experiment by the 'working arty' initiated by Sir Stafford Cripps will be judged. efore it can well start, however, two conditions have o be fulfilled, as Sir Hector Hetherington, himself ne of the court of governors, has pointed out. Staff f the right kind—experienced, lively, knowledgeble and skilled in the Socratic art—must be found; nd the student body must be sufficiently numerous and varied to achieve the fertilizing purpose of mutual riticism and stimulus. It is difficult to see that dequate numbers of students or sufficient variety will be secured without the participation of the Civil ervice; but there can be no question as to the mportance of experiment along such lines, so that ve may be able to secure both the closer integration f industry and business with the work of government nd the service of social needs, and to provide managers and administrators who are fully equipped o deal with the ever-increasing complexities of the ask of administration in the modern world.

ECOLOGY IN THE SERVICE OF MAN

Natural Principles of Land Use

By Edward H. Graham. Pp. xiii+274+32 plates. London, New York and Toronto: Oxford University Press, 1944.) 16*s*. net.

THE theme of this book is set out in its opening paragraph: "We live in an environment of many acets related not as single pieces but as a mosaic, the attern of which is not easily discerned at first glance. t must be seen in different lights before we appreciate ts full design and real worth". Disturbances of one f the pieces of the mosaic may have far-reaching ffects, yet directly man passed out of the hunting nd fruit-collecting stage he began to disturb the pattern, sometimes with unforeseen and disastrous results.

Clearly man must go on interfering with Nature, but he should at least know the consequences of his actions so that he may make them as innocuous as possible. It follows that land utilization must be planned and not haphazard. But a plan involves the detailed study of the region, the classification of its component parts and the study of their mutual inter-relations. Dr. Graham has amassed a great quantity of material much of which will be new to many English readers; he deals largely with American investigations. He shows that the inter-relations between plants or animals with individual factors of their environment can rarely be expressed in simple terms because of the far-reaching nature of their effects. Thus attempts to relate plant-growth with rainfall have succeeded only to a limited extent either in America or in Great Britain. On the other hand, the natural mosaic of any region is a faithful integration of the environmental conditions and so affords reliable guidance about its agricultural possibilities. Hence the need for a close survey which should not be confined to plants, but should also extend to animals, including insects; the soil; the topographical and climatic conditions. He instances the well-known fact that land, which in its natural state is covered with grass and other herbs, is naturally well suited to cereals, while some types of forest indicate suitability to fruit trees.

When natural grass or prairie land is used for grazing, no important change in the flora need be expected provided the grazing is light; but the change becomes very marked when it is too heavy, and deterioration of the herbage then sets in. The changes in any region follow a certain sequence so that the danger can be recognized before much harm has been done, and steps taken accordingly.

Some of the most interesting sections of the book deal with the chain of consequences following on man's disturbance of Nature's mosaic. As one would expect, the 'Dust Bowl', the termination of the soil erosion process, is fully dealt with, as also is the reverse process of rehabilitation. The results of introducing a new component to the mosaic cannot yet be predicted, nor is it clear why the new introduction sometimes romps away and multiplies at a tremendous rate, like rabbits in Australia or water hyacinth in Bengal, and sometimes dies out more or less gradually leaving no trace behind. The converse problem of eliminating one of the components of a natural community presents many interesting possibilities. In Utah, sweetened poisoned bran was set to control grasshoppers. It succeeded, but raised new troubles for apiarists, orchardists, soil conservers and others. Bees were killed, yields of honey went down, pollination was reduced, fruit yields fell, clover seeds did not set, and hence the plants failed to reproduce themselves; the soil cover suffered and soil erosion set in. So the tale goes rippling on, apparently *ad infinitum*, further proving

> "that thou canst not stir a flower
> without troubling of a star".

The author quotes with approval the work of M. A. C. Hinton on rats. The common rat of England was the black rat, which originated in the forests of India and Malaya and came to Britain at the time of the Norman Conquest or the Crusades; it can carry the plague pathogen and was responsible for the Black Death and the Plague of London. Then the brown rat came in from the plains of Asia. It gradually ousted the black rat from the level places and became the common rat in Britain. It has plenty of sins to its charge, but at least it does not carry plague. Before the War, however, the cellars of London were being made rat-proof, and so it found life difficult. On the other hand, flat roofs, sky-lights, cables, etc., were multiplying, and overhead London became a very suitable habitat for the black rat. So being safe from the brown rat, it was multiplying before the War and was becoming the common rat of London. Should plague break out it might become a menace. As Mr. Hinton says: "If you create a vacancy it is your own very difficult business to fill it".

The independent calculations of Fawcett and of Shantz indicate that something like 6–8 acres of cultivable land in the world per head of population are available to provide food and raw material. On present yields and practices this area barely suffices. Higher levels of production must be widely attained, and this will mean more and more interference with the mosaic of Nature.

The book will serve a useful purpose in setting out the principles on which rational land utilization must be based if unforeseen and undesirable effects are to be avoided. E. JOHN RUSSELL.

PRINCIPLES OF EDUCATION

Education

Its Data and First Principles. By Sir Percy Nunn. Third edition, revised, and in part rewritten. Pp. 283. (London: Edward Arnold and Co., 1945.) 7*s*. 6*d*. net.

OF all the late Sir Percy Nunn's numerous and varied writings, this book is the acknowledged masterpiece. Within a comparatively short compass, it reveals his educational doctrine and sets forth the powerful arguments by which he supported it. In a sense it is a summary of his life's work. Published in 1920, and reprinted many times during the ensuing ten years, it reached its second and revised edition in 1930. For this third and, as the sad event has proved, final edition, the author completed the revision himself, and sent the result to England from his enforced exile in Madeira a few weeks before his lamented death.

The previous editions contained fifteen chapters, all of which have been thoroughly revised by him, considerably expanded, and in some places rewritten. A new chapter has been added. The recent remodelling of our school system had made the fundamental problems of education the subject of unprecedented debate and had made it desirable to treat some old questions more fully, and to give new questions their place in the argument of the book. As the author emphatically declared, however, the central thesis of the book remains unchanged; it maintains as firmly as ever that "the primary aim of all educational effort should be to help boys and girls to achieve the highest degree of individual development of which they are capable". It is good to know that the author lived long enough to see with satisfaction that a widespread acceptance of this idea was a striking, and bade fair to be a permanent, by-product of the war years.

The new chapter to which reference was made above is the tenth in this edition and is entitled "Mental Development". The author's eminent work in the teaching of mathematics enabled him to p the whole matter so simply that any intellige person can follow the argument, provided he or s is both able and willing to devote the necessary tir and trouble. One is left, however, with a lurki suspicion that many teachers and administrators w regard this matter as one for the experts, who are no means in close agreement even upon fundament issues. The non-experts will continue to give respe ful attention to the results of 'intelligence test but they will also continue to believe that wh scientific analysis has said its last word, they mu turn to the whole personality, the living child who immediate future is being decided. Fortunately, t Act of 1944 puts an end to the absurd practice making irrevocable decisions about children at t tender age of ten. T. RAYMONT.

BOTANY IN LATIN AMERICA

Plants and Plant Science in Latin America

Edited by Frans Verdoorn. (A New Series of Pla Science Books, Vol. 16.) Pp. xl+384 (38 plates (Waltham, Mass.: Chronica Botanica Co.; Londo Wm. Dawson and Sons, Ltd., 1945.) 6 dollars.

THIS volume contains a great number of articl dealing with the botany and geology of Sou America. The botanical contributions cover a wi field including taxonomy, ecology, plant geograph economic botany, cytology and genetics. There a also accounts of rubber culture, fibre plants and sketch of the geology of the Antilles and a bri account of the general geological features of Sout America.

The editor has enlisted the aid of eighty-five co tributors from South America, the United States an a few from Europe. The book is divided into tw parts, the first of which deals with problems tropical agriculture, phytogeography of the continen economic plants, with a special supplement on pla breeding, genetics and cytology. The second pa consists of revised articles which have appeared i *Chronica Botanica*, chiefly on the floras of differe regions. Many of these articles are of great interes such as "The Falkland Islands" by Dr. Scottsber and "The Vegetation of Ecuador" by Dr. Svenso to mention only two out of more than a dozen o phytogeography. A geological sketch of Sout America is given by Dr. Darrah.

It is impossible in the space of a review to giv any detailed impression of this extensive and vari subject-matter; the index alone covers fourtee pages. The arrangement of the articles does no appear to follow any definite plan, so that referenc to any subject is not easy; even the longer contribu tions are restricted to a few pages and merely r present summaries of extensive subjects. Scatter between these are a number of short notes regardin some regional aspect of agriculture or economi botany. A short bibliography to some of the longe articles is a useful feature.

A number of plates taken from various source embellish the text, and many of the contributio are illustrated by outline maps.

While little detailed information can be obtain from many of the articles owing to their short length this volume can be recommended as a most valuabl general reference book to all botanical and alli subjects in Latin America.

THE MISSION OF SCIENCE*

By Sir HENRY DALE, O.M., G.B.E., F.R.S.

THE scientific men of the world now have before them the task of readjustment which, we may hope, will mean the whole-hearted devotion of the vailable resources of scientific research and development to their proper and beneficent uses. It has become a commonplace that the urgent needs of war have greatly accelerated discoveries and inventions which will now promote the advancement of science and its applications in peace. Some of these scientific words and spears will be thus immediately applicable as peaceful implements, or with only a minimum of beating and bending—radar, for example, to the safety of transport by sea and air, and all the new wealth of chemotherapeutic agents and insecticides o peace-time hygiene and agriculture. There will certainly be many others of a less direct and obvious kind—discoveries and developments arising as side-issues from the urgent uses of science in war, but capable now of applications which may open new possibilities of scientific advance for its own sake, or for a whole range of peaceful purposes. The Royal Society has recently agreed to collaborate with the Service Departments concerned, in setting up committees to organize such peaceful uses of the special facilities for purely scientific observation and experiment as are presented by Service flying, including aerial photography, by the voyages undertaken by the ships and officers of the Royal Navy in the course of their normal duties, and by the large surplus of explosives—of the pre-atomic type, be it understood —which a great war leaves in hand.

Let me make brief mention, by way of another example, of an unexpected gift to science, arising as a curious side-issue from the large-scale application in war of knowledge which science had provided. Some thirty years ago my former colleague, Dr. Charles Todd, published in the *Proceedings of the Royal Society* two papers dealing with the antigenic individuality observed, even within the limits of a single breed of chickens, when the red blood corpuscles of one bird are injected into another. This was an observation, one might think, of an interest purely theoretical, though great; but the widespread application of blood transfusion during the War, to replace blood lost by the wounded, civilians now as well as warriors, has given to phenomena of this type a practical importance. Apart from the familiar natural incompatibilities, due to the known human blood groups, it was found necessary to be alert for reactions in persons who, having had an earlier transfusion, might have acquired, by an immunity reaction, a new incompatibility to the donor's red blood corpuscles. The case of such reactions hitherto most completely studied concerns an antigenic factor which Landsteiner and his colleagues had discovered, early in the War, in the red corpuscles of the Rhesus monkey, and had accordingly termed *Rh*. This factor they found to be present, as a Mendelian dominant, in the corpuscles of most white people, but absent from those of a minority. So, in the slang of the subject, about 85 per cent of people of the white races are '*Rh*-positive', while 15 per cent are '*Rh*-negative'. Now it appears that the blood serum of an *Rh*-negative person, if he receives a transfusion of *Rh*-positive blood, acquires immune substances destructive to the 'positive' red corpuscles. In consequence, he suffers a dangerous reaction if given a second, similar transfusion. This observation has brought to light the much more important fact that, when an *Rh*-negative woman, whose husband is *Rh*-positive, becomes pregnant by him of an *Rh*-positive child, her serum is liable therewith to acquire, and to transmit through the placenta, an antibody destructive of the child's red corpuscles, so that the offspring of such a union are prone to a high rate of mortality, before or soon after birth. Whether those who survive the infantile malady thus produced show a greater liability to other hereditary defects, or whether deleterious maternal antibodies of this type can be formed in relation to other kinds of cells than the red blood corpuscles, are matters on which investigation must be awaited.

I mention the matter as an example of the gleanings which peaceful science may expect from fields of knowledge which war has been tilling and reaping. Unless I am mistaken, the widespread use of blood transfusion has thus been largely responsible for enabling human genetics now to explore a new category of congenital defects, due, not to the coincident presence of a detrimental gene in both parents, but to the possession by a father of one which is harmless, unless it excites an immunity response in a mother who lacks it.

Whether by following in new directions clues which have thus been discovered under the stimulus of war, or by resumption of researches which the War interrupted, it is clearly a matter of urgent importance that our scientific activities should now, as rapidly and as smoothly as possible, reacquire the character proper to peace. There are directions in which official action can accelerate a process of such outstanding significance to the position which our nation will be able to achieve and to hold in a world civilization, now so clearly entering its scientific era. We need our leaders and teachers in science back in the universities, and the students whom they can inspire and train, as rapidly as these can be released from war-time duty and service.

A number of our leading men of science have learned much from war-time experience of organization and team-work in research, and have been freely devoting great abilities to planning and to securing proper conditions for researches by others. It is unlikely that the debt of the nation and of its allies to the work of many of these will ever be fully known, beyond the limits of certain circles. The experience of these men should help them still to serve the nation in peace, by counsel and by advocacy, when the needs of scientific reconstruction demand these.

I venture to hope, however, that there will be no such demands on the time and the energies of those who should now be our leaders in research, as to keep them away from their benches and their studies, and to deprive of their inspiration the younger men who should now be their pupils and collaborators. When the world emerged from the War of 1914–18, the scientific men who in Britain and other countries were then at the height of their powers for research, who, in Newton's fine phrase about himself, were 'in the prime of their age for invention', were back in their laboratories with little delay. As a result, even in the two decades of uneasy armistice which followed, curtailed at both ends by the confusion of recovery from one war and the gathering menace of another, research for the normal purposes of peace was resumed with an astonishing promptitude, and the advance of knowledge surged forward with an imposing acceleration. Almost any man of science who can cast his mind back to the state of knowledge in his own special subject in 1919, and compare it with that which had been reached in 1939, must be impressed by the transformation. To mention an example which cannot be far, at the moment, from anyone's thoughts, consider the revolutionary changes made, between the wars, in our whole conception of the material universe, by new theories of atomic structure, with new apparatus of mathematics to deal with them, by the experimental attack on the atomic nucleus leading to transmutation of elements and, still before war's dark curtain fell again, clear evidence of atomic fission, with the release of atomic energy. As one other example, who would have predicted in 1919 that, of the vitamins and hormones then known and differentiated only by the effects of their withdrawal and replacement, imposing ranges would have been isolated, identified and made by artificial synthesis before 1939 ? Now that we are emerging from another war, into what, if we men of science can do anything to prevent it, will not be just another precarious interlude before a worse disaster, we must try to ensure that the free advancement of natural knowledge, which this Society exists to promote, is able to claim again, with as little delay as possible, the full service of its natural leaders.

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* From the anniversary address to the Royal Society, delivered on November 30.

Another condition of the revival of scientific activity for the normal purposes of peace, seen clearly by our predecessors in 1919, was a rapid reconstruction of the international community of science. Before there had been time for the full attainment of their aim, the forces of cleavage had again begun to operate ; but, as soon as it became possible once again to think of rebuilding what another war had broken, it was the first duty of the Royal Society to ensure that use was made of all that was of proved value in the framework of international collaboration which had been constructed between the wars. Past officers of the Royal Society, especially Sir Arthur Schuster and Sir Henry Lyons, had taken prominent parts in the foundation and development of this organ of international collaboration. Our foreign secretary, Sir Henry Tizard, now coming to the end of his term of office, was early at work preparing for its revival with the chairmen of the British national committees, in consultation with its present general secretary, Prof. F. J. M. Stratton, and with such representative scientific men of other countries as were accessible. Their aim was to review the past achievements and potential value of this system of the international scientific unions, and the possible need for its extension or modification in certain directions. The Council's reports record the progress which has been made.

While, however, the Royal Society has had a special responsibility for our national participation in this existing system, it has always welcomed any opportunity of the fullest and most friendly collaboration with any other agency for the promotion of international friendship and community of action among the scientific workers of different countries. The Society looks forward now to the possibility of collaborating also with any scheme or mechanism for the promotion of international relations in science, which may arise under the general Organisation of the United Nations. We recognize that, through such channels, it may be possible, not only to give most valuable support to the existing unions for int national action in the various fields of scient research, but also to supplement the functions these in many other directions in which the intere of science may yet require to be internationa organized and promoted. The Society stands rea and eager, now as ever, to work with any responsi agency for the restoration and extension of int national friendship and collaboration in science.

In my address to the Royal Society last year, referred to the aim of building anew, and on a fi and broadening foundation, a world community science, as "an aim worthy of our utmost effort a devotion". Can it be doubted now, after what h happened since then, that upon our success achieving that aim may well depend, not only t free progress of science henceforward, but even t survival of civilization ? I have spoken of existi and prospective mechanisms for promoting scienti intercourse between the people of different natior We must use and develop these to the full limit their value, but we shall still want something whi no formal mechanism can restore to us. Meetings national representatives and delegates may, indee do service of great importance to science, as by fran ing and accepting international conventions on uni of scientific measurement, or on technical terminolog but no mechanism which merely brings scienti men together as national representatives, no findi of formulæ or passage of resolutions, will do f science to-day what the world so desperately need

If we are to achieve anything really to meet th need, we must somehow get rid of barriers whic hinder the scientists of different countries from mee ing simply as scientists, for the frank and inform interchange and friendly criticism of each other observations and ideas, in complete freedom fro any national inhibitions or restrictions. Before 191 we were able to claim that science belonged thus t the world, knew no frontiers, was one and indivisibl Many of us had been cherishing the hope that th union of so much of the world in a war for the defenc of freedom—freedom, we understood, for science a for all man's other activities—would have brough with victory, a possibility of reviving this claim an restoring this ideal, which the intervening years ha so shaken and obscured. Even a few weeks ago th trend of events did not appear to encourage tha aspiration ; but we may find, in the end, that it wi suffer less from an open challenge, which all th world can see, than from a more gradual discourag ment.

To all but a few men of science, as to the rest of th world, the use of the atomic bombs on Japanes cities brought the first news of a tremendous scientifi and technical achievement, as well as the recognitio of a new problem of overpowering importance to th world. Scientific workers might well take pride in i as a triumphant verification of a purely scientifi prediction. The main lines of this had been complete before the outbreak of war in 1939, by experimente and theoretical physicists of many countries. W think proudly here of the pioneer part whic our own Rutherford with his pupils and associate had played in the opening of a new science of nuclea physics ; but we recognize that its development wa a widely international achievement. The practica realization in a little over three years of what thes academic scientists had foreseen as a distant poss bility required a scientific and technical undertakin of a new order. It is unlikely that any stimulu her than the urgency of war would have sufficed induce any national, or other, organization embark upon such an enterprise. It is certain at, under the world conditions in which that imulus was applied, the United States of America as the only country in the world where the pro- ct could have been undertaken. The result was prodigy of organization and achievement, both entific and technical; and though, in the nature the case, America made the largest contribu- n even to the team of scientific workers engaged the great volume of theoretical and experi- ental researches still required, we may be glad think that, on that side, the enterprise still wed much to a widely international effort. It drew to its service a large proportion of the nuclear ysicists of Britain and of Canada, with others ho had escaped from the clutches of the German vader in Denmark and in France, and yet others ho had fled before the War from Germany, from ustria and from Italy to conditions of freedom d new opportunity in Britain and the United tates.

The enthusiasm with which the world of science ould normally have received the news of an event such magnitude in scientific history was qualified the unique conditions of its general announce- ent. The world at large has not been slow to grasp e tremendous implications which it may hold for e future of civilization, and the nature of the choice th which it has so dramatically faced mankind. he problems which it has raised are clearly every- dy's concern. Nevertheless, and in spite of certain reats and rumblings, I believe that general opinion ll allow to us men of science, in addition to our mmon rights as citizens, a special claim to be heard the uses which the world is to make of this great w gift of science to mankind. General opinion, I ink, would further recognize that the many scientific orkers who have taken a direct part in this great hievement have a special right and duty to let the orld know how, in the light of their intimate and xpert knowledge, they view the promise and the reat which it offers to humanity. Surely they, if y, have a right to speak; and we others can elcome the firmness and the substantial unanimity ith which many of them have let their opinions be nown. We have a duty, indeed, to the statesmen, ho are carrying this new and heavy burden of sponsibility for the world's future, and who have deal with aspects of the problem in which science not directly concerned. It is a part of that duty, wever, to keep them in touch with the general dy of opinion among the scientific workers of the ee peoples whom they represent, so that, in framing eir policy, they may be confident that the service quired of science to make it effective will be given ith enthusiasm and conviction, and not, if at all, ith a reluctant acquiescence. Most, if not all of you, ll have read words which the Prime Minister spoke the Canadian Parliament, and emphasized by peating them to our own House of Commons a eek ago. "Unless we apply to the solution of these roblems a moral enthusiasm as great as that which ientists bring to their research work, then our vilization, built up over so many centuries, will rely perish." I do not doubt that you will share my ow of gratitude for a tribute which we must try deserve.

It is not fitting that I should discuss here matters hich belong to a much wider constituency than ours, and my particular purpose to-day is to ask you to consider an aspect of this world problem, which is, beyond challenge, our special concern as men of science—the effect of present and prospective developments upon the integrity of science itself. Will any deny our claim to hold that as a sacred trust for the world, and to be alert to defend it from any danger which may seem to threaten it? I believe that we have a duty to be watchful now against a serious danger to it from the intrusion of secrecy, which we know here from long tradition and experience to be alien to the spirit of science as we have known and cherished it. I cannot claim the time which would be required to deal adequately with such a theme. Permit me, however, to bring certain aspects of it briefly to your notice, without attempt at full or ordered discussion.

1. This danger, of course, has not newly arisen with the explosion of the first atomic bomb. We have known it long in connexion with the use of scientific research by industry, and with the relatively minor and accessory part played, until recently, by science in preparing the apparatus of war. Even in those connexions, there was a growing recognition of the detrimental effect of secrecy on the relations between the scientific men concerned and the general scientific community, and a consequent effort to reduce its applications to the minimum which industrial or military opinion would accept.

2. The real and growing danger arises, however, from the new conception of war, due to the breach and consequent abandonment, in rapid succession, of conventions and restrictions which, not long ago, seemed permanent and sacred. Thus by the end of this recent War, step by step, with Germany always leading, the combatant nations had come to regard, as a proper war aim, not merely the winning of mastery over the enemy's fighting forces, but also the compulsion of his surrender by indiscriminate destruction, by any means, of his people and their possessions. This principle of 'total war', as we learned too easily from our enemies to call it, having once been accepted, science found itself no longer a mere accessory of military action, but increasingly a central agent, a direct combatant, and the provider of a limitless vista of destructive possibilities. Last year I spoke of the warning of such developments which the German 'V' weapons had given, and the dropping of the first atomic bombs has now given to that warning a new and a sterner emphasis.

3. Preparation by our enemies for the use of science in such total war, and our own for defence against it by reprisal, have alike involved the binding of a nation's scientific effort to secrecy on a scale beyond all earlier experience. This we accepted readily, with so much else, as a necessity of war. The freedom of science, as of all that made life worth living, was at stake; if by submitting for a while to secrecy we could help to save that freedom and to establish it for ever, we could not hesitate; but we must be watchful now against any easy assumption that that submission will be continued into peace.

4. As has now been recognized by international pronouncement, it cannot be assumed that the atomic bomb, or any contrivance using the release of atomic energy, represents the only direction, or even of necessity the most effective one, in which science could be perverted to the purposes of this 'total war', as a direct agent for the destruction of one people by another, or of dominance by the threat of it. The atomic bomb has given immediate prominence to the

problem, but the world might have had to face it, even if the attempt to release atomic energy had failed, or had never been made. The nations, in fact, have now to decide how they intend to use the powers and the resources which science stands ready to offer in growing abundance. Will they let science work again and henceforward in freedom, once more as an international community, and use what it offers for the raising of all mankind to levels of material prosperity and of culture above any that we can picture ? Or will they try still to bind science to secrecy, for the competitive invention of ever more effective means of destruction, and thus hold civilization in instant peril of dissolution ? It is surely our duty as men of science to help the world with our knowledge to make that decision, and to make clear our own views and intentions.

5. The danger to science from the intrusion of secrecy, against which I suggest that we need to be alert, does not arise, of course, simply from the question whether a particular technical invention shall be given away at once, or not until somebody else has made it. If policies now developing can bring about a frank and effective abandonment of all national secrecy about science, we need not, as men of science, be critical of their beginnings. Our experience so far, however, of the application of secrecy to science for military or industrial advantage must keep us on guard. It has not, in our experience hitherto, dealt with inventions which can, once for all, be locked up or given away. The most that it has hoped to achieve has been to keep its particular employer, at each new stage, a jump ahead of his rivals. What we have now to fear is that, in default of the international agreement which we must hope and work for, national military secrecy should try to maintain, or to extend, its war-time dominance. If that were to happen, we must expect it, with its new experience of the possibilities of science in total war, to be watchful for any advance, whether fundamental or technical, whether in nuclear physics or in any other progressive field of science, which could be impounded and put under seal for war-like preparation, presumably under the name of 'security'. It is impossible to forecast how much of science might thus become involved. The release of atomic energy is yet a novelty, and we have to think what might be made of it, for good or ill, twenty, thirty or forty years ahead. I think that we, as men of science, should make it clear to the world that, if national military secrecy were allowed thus progressively to encroach upon the freedom of science, even if civilization should yet for a while escape the danger of final destruction, a terrible, possibly a mortal wound would have been inflicted on the free spirit of science itself, to the immeasurable loss of what it stands ready to offer to a wiser world.

6. I do not believe that there is any division of opinion on this issue among scientists, anywhere in the world, in so far as they are able to express it simply as scientists. We scientists of the United Nations, in despite of all our normal traditions and instincts, were ready to submit for years to any secrecy or restriction which could help or hasten victory in the War for the world's freedom. The War has been won, and we shall not be ready to accept, as its result for science, a tightening of the chains. We have the right to expect that its freedom will be restored; and the freedoms which we ask for science are freedom from secrecy and freedom from national barriers.

7. Secrecy as the enemy, and resistance to t attempt of authority to impose it, are no n experiences for science or for scientists. Giorda Bruno was burned at the stake and Galileo w imprisoned and threatened, because they refused be secret about discoveries which were thought to harmful to religion in their day; and, in a lat century, there was an attempt, for a like reason, discourage scientific men by moral ostracism fro telling the truth as they had seen and discovered Science was not halted, the world still moved, the mor stature of mankind was raised by the encounter, a organized religion gained more from it in wisdom th it lost in intellectual dominance. We do not kno yet who, or how many, of Europe's men of scienc in the terrible years now closing, have suffered for t scientific truths which political tyrannies desired suppress or to distort. Unless the growth of inte national understanding and confidence can no prevent it, unless efforts to outlaw the abuse science for 'total war' should succeed, science ma find itself again facing an attempt to impose secre upon it, this time in the interests of national suspici and rivalry, and in flat negation of its true service mankind. If that danger should threaten, can v hope that the scientists of all the world may y stand together against it, determined to preser the integrity of science, to prevent its further pe version from its proper and beneficent uses, and save civilization from misusing science for its ow destruction ?

Our Charter of 1663 lays down, as the object of t Royal Society, "promoting by the authority experiments the sciences of natural things and useful arts, to the glory of God the Creator, and t advantage of the human race". Each of us may re these old words to-day in terms of his personal co victions. Freely to seek "by the authority of exper ments" and freely to proclaim the truth as scien reveals it, for its own beauty and excellence and f the help, the healing and the enlargement of th means of happiness which it can bring to all mankin —does any man of science, anywhere in the worl whatever his creed or his loyalties, desire for scien any aim but this ? The old mandate still embodi the purpose for which the Royal Society has stood f more than 280 years, and still must stand, as a beaco to the world and as one of its centres of inspiratio

AN ELECTRICAL HYPOTHESIS OF SYNAPTIC AND NEUROMUSCULA TRANSMISSION

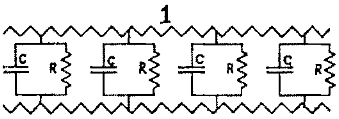
By PROF. J. C. ECCLES, F.R.S.

Physiology Department, University of Otago

SINCE 1933 the transmission of impulses acro synaptic or neuromuscular junctions (hencefort called junctional transmission) has been the occasio of a controversy[1]. The electrical hypothesis ha had the grave defect that (except for the falsifie isochronism theory) it has never been stated i such precise terms that it could be subjected t crucial tests[1,2,3,4,5,6]. On the other hand, th chemical hypothesis in its original form (acetylch line as transmitter) was falsified by an investigatio of the action of eserine, and has had to be modifie by the addition of *ad hoc* hypotheses[7]; but t ation remains unsatisfactory because there seems e hope of testing these *ad hoc* hypotheses inde- dently, and because recent work suggests that mical transmission plays a subordinate or negli- e part in junctional transmission in sympathetic glia[3] and the spinal cord[4]. Meanwhile, during last eight years important advances have been de in the investigation of the electrical properties erve fibres, and of the electrical events occurring junctional transmission; hence the time has med opportune to elaborate on these bases an trical hypothesis (or model) of transmission that apable of experimental test.

he initial assumptions of the hypothesis are: That the geometrical situation at the junction y be schematically represented by the terminal ve fibre ending as a cylinder with a closed end in se apposition to the large plane surface of the effector (nerve or muscle), as is shown in longitudinal tion in Fig. 2. (*B*) That in general the surface mbranes have the electrical properties demon- ted for peripheral nerve and muscle membranes— embling a leaky condenser (in Fig. 1, *C* is about μF and *R* about 400–1,000 Ω per sq. cm.) ich has a resting charge of 50 mV., and which o acts as a rectifier[8,9,10,11], outwardly directed rents (cathodal) decreasing *R* to as little 1/13, while anodal currents have the reverse ect. For present purposes the inductance[8] of the mbrane will be ignored, because the absence of illatory potentials in the electrical responses of mal vertebrate nerve and muscle suggests that it much smaller than in the squid. Both exterior d interior have the conductivity of a weak (0·6–) per cent) salt solution. (*C*) That the junctional ion of the effector cell has unique electrical perties, in that cathodal polarization (lowering of ting charge) sets up a graduated 'local re- nse'[12–18] with a temporarily irreversible and ge diminution of potential and resistance (cf. ref. 8, 46), but not the all-or-nothing membrane 'break- wn' characteristic of the propagated impulse. It y be likened to the nerve membrane in a refractory, esthetized or deteriorated condition[15,18,19].

Assumption *A* is based largely on the generally epted histological picture of the junction, but ctrical investigation also shows that there is a nsverse membrane[1]. Assumption *B* is based on ect measurements on nerve and muscle, and on evidence that nerve cells resemble nerve fibres in ir electrical excitability[8] and in the propagation impulses from a nerve cell to its axon and vice sa[8,20]. Assumption *C* is based on the responses nerve under special conditions (as above) and on ect observation of the electrical response set up a nerve impulse at an isolated neuromuscular ction before and during curarization[21]. This l-plate potential rises smoothly to the full height the spike potential without showing the sudden lexion characteristic of impulse initiation. The pulse appears to be initiated a little later by an acent region of the membrane when it reaches a tical intensity of catelectrotonus. Progressive arization produces *pari passu* a diminution in the d-plate potential, impulse initiation occurring acently at lower end-plate potentials and after ger delays. It may therefore be assumed that junctional region of the muscle is specialized to e 'local responses' of high and graduated intensities hout incurring the membrane breakdown charac- stic of the impulse[21]. This evidence of its unique electrical properties can be related to its well-known unique pharmacological properties[22,23]. Assumption *C* is extended to the synaptic regions of nerve cells.



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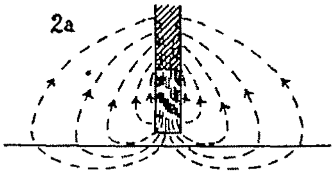

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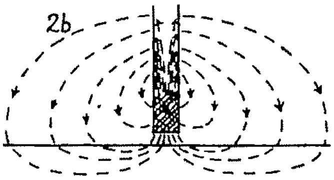

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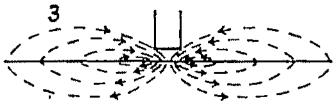

3

It appears that, assuming *A* and *B*, we have to expect that the current generated by an impulse propagating into a nerve terminal will in part penetrate the effector cell and give a diphasic action, first an anodal focus at the junctional region with a cathodal surround (Fig. 2*a*), which quickly reverses when the peak of the impulse reaches the junction (Fig. 2*b*). The penetrating current will be limited by polarization of the membrane condensers, and in the initial phase by the increasing resistance at the localized anode. On account of its much larger area, the membrane resistance at the cathodal surround will be so much lower that its simultaneous diminution will be relatively insignificant in tending to increase the flow of penetrating current. However, in the second phase the situation is reversed, because the lowering of the initially high resistance at the localized cathode will have a preponderating effect in increasing the flow of current; hence a much larger penetrating current will flow in the second phase than in the first phase, the current being as it were canalized through the localized low resistance at the cathode (cf. ref. 8, Fig. 3). According to assumption *C*, this cathodal current of high density would evoke at the junctional region of the effector cell an intense 'local response' which would run through a cycle of increasing and decreasing intensity, much as does the spike response of a propagating impulse[15,16,17,18,19]. This local response thus would outlast the second phase of penetrating current flow, and provide a relatively enduring focus of very low polarization and resistance through which adjacent regions of the membrane proceed to discharge (Fig. 3). (Assumption *C* here is essential for the hypothesis.) The anodal surround of Fig. 2*b* therefore gives place to a catelectrotonically polarized surround which spreads spatially according to the 'core conductor' theory. Such catelectrotonic potentials have been observed to play an essential part in all junctional transmissions so far investigated. It has further been shown that these potentials have a time course which may be interpreted as due to a brief active depolarization and a passive exponential decay governed by the electric time constant (the product CR in Fig. 1) of the membrane[4,6,15,24,25]. In the present theory the active depolarizing action is provided by the local response of the junctional region of the effector cell, not directly by currents generated in the nerve terminals, as has hitherto been assumed in hypotheses of electrical transmission.

The remainder of the hypothesis is on conventional lines, the catelectrotonus setting up an impulse in the effector cell when it attains a threshold value, just as occurs with an artificially evoked catelectrotonus[4,6,15,25]. With muscle the impulse arises in the membrane adjacent to the end-plate region[21]. With nerve cells the catelectrotonus from the diverse synaptic region sums to give the synaptic potential, which provides a satisfactory explanation of all the phenomena hitherto attributed to the central excitatory state[3,4,24].

Thus the sequence of events in junctional transmission is envisaged as: (1) Impulse in terminal nerve fibre generates a current which gives a diphasic effect at the junctional region of the effector cell with a total duration of probably not more than 1 m.sec. in mammalian muscle and spinal cord: (*a*) initial anodal focus with cathodal surround; (*b*) more intense cathodal focus with anodal surround. (2) This cathodal focus sets up a brief and intense local response at the junctional region. (3) From this local response a catelectrotonus spreads decrementally over the effector cell membrane. (4) A propagated impulse is set up in the effector cell if this catelectrotonus is above a critical value; if it is below, then as the local response subsides, the catelectrotonic surround decays passively.

The hypothesis offers an explanation of the following observations on junctional transmission.

(*a*) Irreversibility of junctional transmission would be predicted because an impulse in the effector cell would sweep past the nerve terminals on the surface and exert on them also the third phase of anodal depression as predicted by the theory of electrical interaction and observed in artificial synapses[2,26,27], so abruptly terminating the local cathodal effect.

(*b*) The delay in onset of the local response and catelectrotonus of the effector cell (synaptic or junctional delay) is attributable to the initial penetrating current setting up an anodal focus, which has to be removed by the reversed current before the cathodal focus would be built up sufficiently to generate the local response; that is, there would be a delay until the impulse at the nerve terminal was on its declining phase. The observed value of about 0·6 m.sec. for mammalian neuromuscular junctions[25] and central synapses[4] accords well with this explanation. A further delay of about 0·2 m.sec. is attributable to the time of rise of the catelectrotonus to the threshold for impulse discharge[4,25].

(*c*) The brief phase of low resistance (additional to the catelectrotonic effect) during the initial part of the end-plate potential[11] is attributable to the local response at the junctional region, which, because of its sharp localization, would contribute relatively more to current flow than to potential.

(*d*) Analysis of junctional potentials gives a time course for the active depolarizing agent corresponding to that expected for the local response of the effector cell[4,6,15,24,25].

(*e*) If the junctional region cannot give the all-or-nothing impulse response (assumption C), its 'local response' might be expected to survive
transmission of a muscle impulse whether gener
adjacently or propagating past—as is found to o
for the active depolarizing agent[15].

(*f*) The hypothesis would predict that a
propagated catelectrotonus of the effector cell,
example, a synaptic potential, would give rise
sharply localized cathode at the nerve terminal
hence produce there the same conditions as occu
in the effector cell in Fig. 3. Catelectrotonus sprea
from this focus provides an explanation of the d
root potentials[28].

In its present largely qualitative form, the tes
of the hypothesis may be considered at two le

(i) The picture of the diphasic flow of penetra
current and the cathodal focus is based on assu
tions A and B. In connexion with the pre
hypothesis, assumptions A and B are to be conside
in the main, as established rather than as ope
tests by experiments on junctional transmiss
The mechanism of this action has already been in
tigated in the artificial synapse or ephapse made
two nerve fibres in close apposition[2,14,26,27]. (F
2, 3, 4, and 5 of the first paper are particul
pertinent as they show a 'terminal' effect with
initial diphasic wave generating a local resp
exactly as predicted by the present hypothesis.
oscillatory decline of this local response may
related to the high inductance of the squid n
membrane[8].) Further study of ephaptic transmis
will provide a test for this aspect of the hypothe

(ii) The hypothesis states that the cathodal f
at the junctional region is adequate both in inten
and time course to set up the observed local respo
the subsequent spreading catelectrotonus and fin
the propagated impulse. These predictions sho
be testable by transmission experiments. In pa
cular the tests would attempt to evaluate the
of the chemical transmitter, which is relegated
a subsidiary position by the present hypothe
The action of eserine indicates that the juncti
of nerve-muscle[7], the sympathetic ganglion[3], and
spinal cord[4] form a series of decreasing significa
for chemical transmission.

A crucial test for the electrical hypothesis
be its ability to explain the junctional block
curare. Since curare is known to act specifically
the junctional (end-plate) region of muscle[22],
since the block is explained by the observed depres
of the junctional potential[8,21,25], the simplest expla
tion is that curare depresses the local response
up at the end-plate by the cathodal focus, t
is, it depresses the electrical excitability of
end-plate. In a recent attempt to test this
electrical stimulation of the isolated neuromusc
junction before and after curarization[23], the initiat
of propagated muscle impulses was used as
criterion of end-plate excitability. Yet, if the e
plate region reacts by local responses rather t
by propagating impulses (assumption C), it see
probable that this investigation tested the exc
bility of regions adjacent to the end-plate, confirm
the previously observed absence of curare act
there; that is, it provides no evidence for or aga
a specific depression of end-plate excitability. H
ever, if curare blocks solely by its known depress
effect on chemical transmission, then, in a very d
curarization, the residual catelectrotonic effe
produced by the cathodal focus (that is, by electri
transmission) should be observable uncomplicated
chemical transmission. The problem of curare act

articularly significant, because it also specifically ks transmission through sympathetic ganglia[24], re chemical transmission seems to play a subor- ate role[3].

n conclusion, it may be stated that the present othesis will have to stand up to many severe s, particularly pharmacologically. Mathematical elopment has been beyond my competence and y be premature, though it should be possible; the absence of quantitative prediction as regards nsity of action is a grave defect. Nevertheless, the basis of the properties observed for peripheral ve and muscle membranes, the hypothesis gives tatement of electrical transmission sufficiently cise (particularly as regards time course) for erimental testing, offers a coherent explanation many previously unrelatable observations, only e of which are mentioned in this preliminary ount, and has already proved fruitful in suggesting experimental investigations.

wish to thank Dr. K. R. Popper for his stimulating helpful criticism.

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OBITUARIES

Dr. J. C. Merriam

he death on October 30 of Dr. J. C. Merriam the age of seventy-six will be deplored by all ontologists and many other scientific men.

After a training under von Zittel in Munich, rriam went to the University of California to teach eontology and historical geology, and in time ame professor and head of the Department of ology.

ot long after his appointment, Dr. Perrin Smith, o was working on ammonites, gave Merriam some gmentary remains of reptiles from the Upper assic Trachyceras beds of Shasta Co., North ifornia. These proved to belong to Ichthyosauria, Merriam based on them the first satisfactory ount of any Triassic member of that group. The obvious importance of this find enabled Merriam to interest Miss Alexander, and with her help he was able to take expeditions into the field, which, in several years, not only collected much Upper Triassic material but also found new localities in Nevada where well-preserved Middle Triassic Ichthyosaurs could be collected. The whole material was described in an admirable monograph.

Merriam also recognized that some of his material was not ichthyosaurian but belonged to members of an entirely new order of aquatic reptiles, which he described as the Thalattosauria in another splendid monograph.

Dr. Merriam then turned his attention to fossil mammals, exploring the John Day region of Oregon, giving us an account of the stratigraphy, and descriptions of many new or little-known animals found in it. From this, led by an accidental find, he went on, with the aid of his students, to explore other regions of the western part of the United States, work of great importance because our knowledge of Tertiary mammals depends so largely on materials from the Plains and Great Basin of the Rocky Mountains, the whole country to the west having been barren.

Merriam's well-directed and long-continued explorations not only showed us many successive faunas from the west, but also in some cases gave us mammal faunas from rocks in a marine succession, and thus for the first time enabled us to correlate the terrestrial formation of the interior of the continent with the 'normal marine succession'.

In 1920, Merriam was appointed president and chief administrative officer of the Carnegie Institution of Washington, but he still retained his interests in palæontology, himself continuing to work on fossils and supporting the work of other men. After his appointment to Washington, Merriam became much interested in the problem of the time at which man first appeared on the American continent, drawing up a detailed discussion of the evidence in a report to the Sixteenth International Geological Congress in 1934. In this he showed that man had been a contemporary with some extinct mammals in America.

But Merriam's interests ranged widely: he wrote much on national parks, on the wide diffusion of culture among the 'common men', on many social problems of the modern world, and on spiritual values. He was in fact a man entirely worthy of the influential position he filled, and he was also a palæontologist of the first rank.

D. M. S. WATSON.

Prof. Velyien Henderson

WE regret to record the death of Prof. Velyien Ewart Henderson, of Toronto, on August 6 at the age of sixty-eight. Prof. Henderson was born and educated in Canada and took his M.B. at Toronto in 1902. After a period as demonstrator in the University of Pennsylvania he studied at Prague and at Marburg under Hans Horst Meyer. He was appointed demonstrator of physiology in Toronto in 1904, lecturer in pharmacology in 1906 and professor of pharmacology in 1909. Except for a period of service in the Canadian Expeditionary Force during 1916–18, he was at Toronto for the remainder of his life.

At Marburg, Henderson worked on diuresis and on the salivary glands. With Otto Loewi he discovered that the vasodilator nerves in the chorda tympani are not antagonized by doses of atropine, which antagonize the corresponding effect of drugs acting like acetylcholine. This fact provides a complication in the theory of the mode of action of cholinergic nerves, and this topic provided Henderson with one of the interests of his life. In 1932, with Roepke, he demonstrated the liberation of acetylcholine in salivary glands on stimulation of the nerve chorda tympani, and much other work on this and allied drugs has come from his laboratory.

Henderson's main interest in recent years was in anæsthetics. With G. H. W. Lucas he was responsible for the discovery of the properties of cyclopropane as a general anæsthetic in 1929. Though it is difficult to make and administer, this gas has been widely
used because it is a powerful anæsthetic without t
actions and is rapidly eliminated. This discov
formed part of a prolonged pharmacological stud
the properties of a number of similar substances.
addition to these major investigations, Hender
published papers on a wide range of other top
including morphine miosis, expectorants, intest
peristalsis, the respiratory centre, and the mechan
of erection. The late Sir Frederick Banting o
much to the encouragement given to him by H
derson in the early days of work on insulin.

Pharmacologists all over the world mourn
passing of a very lovable man who achieved m
for the advancement of knowledge and the wel
of mankind.

J. H. GADDUM

NEWS and VIEWS

Anniversary Meeting of the Royal Society

SIR HENRY DALE completed his term of office as president of the Royal Society at the anniversary meeting on November 30, and the main part of his address is printed elsewhere in this issue (p. 677). Speaking of domestic affairs, Sir Henry recorded the Society's thanks to the several people who undertook the guardianship of its historical treasures, now safely returned to London. He also announced that the Society is to increase the number of annual elections to twenty-five. Sir Henry himself, when he was a secretary of the Society, had a part in the movement which led in 1931 to the increase of maximum annual admissions to seventeen from fifteen, at which figure it had remained from the time when limitation was imposed eighty-three years before. In 1937, the number was raised to twenty; and now it is to be made twenty-five. This action has been taken in recognition of the recent rapid growth in number of those who have produced evidence of real scientific achievement. Sir Henry also referred to the election this year of two women to the fellowship of the Royal Society, following an alteration to the statutes to elucidate a legal position which had existed since 1919. He admitted that the decision was contested, but expressed his belief that the change was a normal adjustment of the Society's practice "to the growth in extent and distinction of women's contribution to the advancement of science by research".

The officers of the Royal Society as now announced are: *President:* Sir Robert Robinson; *Treasurer:* Sir Thomas Merton; *Secretaries:* Sir Alfred Egerton and Dr. E. J. Salisbury; *Foreign Secretary:* Prof. A. V. Hill; *Other members of Council:* Dr. C. H. Andrewes, Dr. W. T. Astbury, Prof. P. M. S. Blackett, Dr. E. C. Bullard, Prof. I. de B. Daly, Prof. R. A. Fisher, Dr. C. Forster-Cooper, Prof. F. E. Fritsch, Dr. S. Goldstein, Prof. E. L. Hirst, Prof. W. V. D. Hodge, Dr. G. M. Holmes, Prof. H. W. Melville, Prof. R. A. Peters, Dr. D. R. Pye, Prof. S. Zuckerman.

Sir Robert Robinson: President of the Royal Society

SIR ROBERT ROBINSON, Waynflete professor of chemistry in the University of Oxford, who has just been elected president of the Royal Society, is recognized throughout the scientific world as one of the most outstanding and versatile of organic chemists.
His researches not only embrace all fields of p
organic chemistry but also include notable contri
tions to subjects of biological interest, such as a
malarials and phthioic acid. As a research stud
under the late Prof. W. H. Perkin, Robinson
early initiated into the chemistry of the alkal
and other natural products, and he soon became
outstanding figure in the famous Manchester sch
The unique collaboration between Perkin and Rol
son thus established was continued until the form
death in 1929. While still less than thirty year
age, as professor in Liverpool, Robinson publis
his famous synthesis of tropinone, noteworthy
account of its simplicity and intuitive brilliance. T
was quickly followed by a theory of biogenesis
plant products which collated for the first time
apparently dissimilar alkaloidal structures and wh
still stands as one of the most outstanding contri
tions to the chemistry of natural compounds. Am
other significant investigations in this field, ment
may be made of Robinson's morphine formula,
universally accepted, and also his classical work
the elucidation of the structures of brucine
strychnine.

On his return to Manchester as head of the Dep
ment of Organic Chemistry and with more stude
available, Robinson's research programme rapi
expanded, and he turned his attention to the prob
of the anthocyans, the naturally occurring pigme
of flowers and fruits. The synthesis of these
achieved in a comparatively short time and c
stitutes possibly the most brilliant example of plan
research in organic chemistry. Less widely rec
nized but of equal importance is his work on
synthesis of the anthoxanthins, whereby read
accessible routes were secured for the preparation
a wide range of many naturally occurring flavo
flavanols and *iso*flavones. In 1930, Robinson w
to Oxford as Waynflete professor. By 1935 m
attention was being focused on sterols and rela
compounds, and Robinson, together with his stude
and collaborators, embarked upon the diffic
problem of the synthesis of the secondary sex hor
ones. Once again his mastery of synthetic meth
has been demonstrated in a series of memoirs n
worthy for their freshness of approach. Arising
of this work, Robinson, in association with P
E. C. Dodds, was responsible for the discovery
stilbœstrol, the first synthetic œstrogen.

During the war years, notwithstanding much he
and responsible work on behalf of the Governm

Sir Robert Robinson still found time for new researches, and it is no secret that for the past five years he has concentrated much attention upon the problem of the structure and synthesis of penicillin. Reference must also be made to his electronic theory of organic reactions which, classifying on a common basis a diverse mass of data, has had a profound influence on the development of chemical thought. Sir Robert Robinson has indeed imprinted his genius upon every branch of organic chemistry. Throughout his career, students have flocked to his laboratory from all parts of the world, and while still less than sixty years of age he has the satisfaction of seeing his former students occupying some of the most prominent positions both in academic life and in industry.

Rowett Research Institute: Dr. D. P. Cuthbertson

David Paton Cuthbertson, who has been appointed head of the Rowett Research Institute in succession to Sir John Orr, graduated B.Sc. from the University of Glasgow in 1921 as a pure chemist. He was awarded a Ministry of Agriculture scholarship and commenced his research work in the biochemical laboratory of the Institute of Physiology at Glasgow. He soon realized that to carry out effective investigations in biochemistry he must have more biological knowledge, and accordingly he resigned his scholarship and began the study of medicine. He graduated M.B., Ch.B. in 1926 and, shortly after graduation, he was appointed the first clinical biochemist at the Royal Infirmary, Glasgow. He rapidly developed this post and managed to have attached to his laboratory a small number of beds for the study of metabolic disorders. In 1934 he returned to the University of Glasgow as Grieve lecturer in physiological chemistry. The Medical Research Council in 1943 applied for the loan of his services to act on its secretariat. In this last post he was appointed scientific secretary to a number of the Council's sub-committees and thus gained a very wide experience of the varied research work carried out on behalf of the Council. Earlier this year he accepted an invitation from the Government to visit Newfoundland to report and advise on the means requisite to alleviate the recognized nutritional deficiencies. He obtained the degrees of D.Sc. in 1931 and M.D. with honours in 1937. He also worked for a period in the biochemical laboratory of the University of Leipzig under Prof. Karl Thomas. Dr. Cuthbertson's research work has been mainly in the metabolic field, and particularly that of protein metabolism. His most interesting and outstanding contribution has been a series of papers on the metabolic reactions of tissues to injury with special reference to the effects of fracture of bones and of the immobilization of limbs.

Physical Society Awards: Duddell Medal

The Duddell Medal of the Physical Society is awarded at suitable intervals, usually annually, for the invention of scientific instruments or of materials used in their construction. The Council of the Society made the twenty-ninth (1945) award to Prof. J. T. Randall, professor of natural philosophy in the University of St. Andrews, for his very valuable work on phosphors and the cavity magnetron. The presentation is to be made on December 12, when Prof. Randall will deliver an address at a meeting of the Society at the Science Museum.

Before the War, Prof. Randall had made important contributions to the X-ray study of structure (notably those of carbon, graphite and glasses) and was also an early worker in electron diffraction. His investigation of luminescence just before and during the early part of the War, and his elucidation of the nature and depth of the 'electron traps' in phosphors, was a fine piece of work on the experimental side, and showed a complete grasp of theory. During 1939–43 he worked for the Admiralty as a member of the special team at Birmingham under Prof. M. L. E. Oliphant, mainly concerned with the research and development of valves for operation on high powers for centimetric radar. Assisted by Boot, Randall was responsible for the very brilliant adaptation of the already-known split-anode magnetron into the cavity magnetron, which enabled exceedingly high powers to be provided on centimetric waves. Randall's cavity magnetron and Sutton's *V-M* valve are basic to the present high pitch of perfection attained in British radar technique and in that of the United States; without them radar might have been relatively ineffective. Both units are destined to play important peace-time parts, particularly in air and sea navigation.

Charles Vernon Boys Prize

By the will of Sir Charles Boys, provision was made for the foundation by the Physical Society of a memorial to one of its most distinguished past presidents, and the Council of the Society decided that it should be a prize to be awarded annually for experimental work either still in progress or completed not earlier than ten years before the date of the award. The first (1945) prize has been awarded to Dr. A. H. S. Holbourn, of the Clarendon Laboratory, Oxford, for his successful measurement of the angular momentum of circularly polarized light. Before this work, it was uncertain whether this momentum really was $h/2\pi$. Holbourn succeeded in suspending a half-wave plate on a $\frac{1}{4}\mu$ silica fibre and, working under good vacuum conditions, he was able to measure the torque produced when the direction of rotation of circularly polarized light was reversed in its passage through the plate; torques as small as 2×10^{-11} dyne cm. were measured with an accuracy of 3 per cent. Apart from its great theoretical significance, this experiment represents a most delicate piece of manipulative work comparable with Boys' construction of the radiomicrometer. It was described briefly in *Nature* (**137**, 31; 1936) and the *Journal of Scientific Instruments* (**16**, 331; 1939) and at greater length in a D.Phil. thesis (Oxford, 1938). Historically, it is interesting to note that the work was carried out in a compartment of the same cellar of the Old Clarendon Laboratory in which Boys himself measured the mean density of the earth. The presentation will be made at the meeting on December 12.

Organic Chemistry at the Royal Technical College, Glasgow: Appointment of Dr. F. S. Spring

The chair of organic chemistry at the Royal Technical College, Glasgow, last occupied by the late Forsyth James Wilson, has now been filled by the appointment of Dr. F. S. Spring, of the University of Manchester. Dr. Spring graduated with honours in chemistry at the University of Liverpool in 1928, and while holding a United Alkali research scholarship followed by a University fellowship he carried out research on the chemistry of the sterols with Prof. I. M. Heilbron, being duly awarded the Ph.D.

degree. His first academic appointment was as assistant lecturer in organic chemistry at Manchester in 1930, under the late Prof. Lapworth. With the appointment of I. M. Heilbron to Manchester on the retirement of Lapworth, the Heilbron and Spring collaboration was resumed, and many papers, particularly on the chemistry of ergosterol, vitamin D and related compounds, testified to the success of the collaboration. With the departure of Heilbron to the Imperial College, London, Spring continued his interest in the chemistry of natural products, going on to studies in the triterpene group and especially the constitution of the α- and β-amyrins. He was awarded the D.Sc. (Manchester) in 1937, and made a senior lecturer in 1941. More recently, with an active research team, he has broken new ground in studies on the application of the Hofmann reaction to the synthesis of heterocyclic compounds, and in addition has carried out investigations for the Colonial Products Research Council.

At Manchester, Dr. Spring proved himself a very successful teacher and an able lecturer, his interest in the chemistry of natural products adding enthusiasm to his lectures to medical students and others. He has always been a staunch supporter of the Chemical Society, being at present a member of its Council, and, as well as being a frequent contributor of original papers, he has taken a very active part in the compilation of the annual reports published by the Society. During the War, Dr. Spring has acted as senior gas adviser to the North-West Regional Commissioner, and was responsible for the training of gas identification officers in this area, and, in association with Prof. A. R. Todd, carried out research for the Ministry of Supply.

Statistics in the Modern State

In his presidential address to the Royal Statistical Society on November 22, Lord Woolton said that the progress in statistics in public affairs in Great Britain during the last half-century has enabled the reading public to form political opinions and provided precise information for Ministers of the Crown, business men and the trade union movement. By 1939 the supply of information was comprehensive enough to show the size of the resources of the country and how they were being used; but there were many gaps in the information available, and those who found themselves in 1939 responsible for the government of the country in the rapidly changing conditions of the War had very little to help them. The proved competence of the statistician, both in the field of financial forecast and in the operations of Government, have given much stimulus to those who believe in national planning, and in particular, to its use in preventing economic waste and personal tragedy. Unemployment is the most urgent social problem confronting the modern State, and Lord Woolton believes that the use of the statistical method of ordering those operations of our economic life that are within the control and competence of Government can in a large measure solve the problem. We must have knowledge of facts, and capacity to forecast future trends from those facts; but it is useless and aggravating to call for information in greater detail than is necessary to provide proper guidance to action. Enumerating the principal classes of statistics that must be obtained for the efficient operation of an employment policy, Lord Woolton said that to collect the information involves maintaining close collaboration between statisticians in Government services and their professional colleagues in trade associations, in the universities and research institutes.

Committee on Scientific Man-power and Resources

Mr. H. Morrison, Lord President of the Council announced in the House of Commons on November 29 that he has appointed a Committee "to consider the policies which should govern the use and development of our scientific man-power and resources in the next ten years". The Committee is being asked to produce an early interim report to facilitate forward planning in fields which are dependent on the use of scientific man-power. Later the Committee will be asked to make recommendations for the establishment of permanent machinery for carrying out surveys into the best use of the scientific resources of Britain in the national interest. The Committee is constituted as follows: Sir Alan Barlow (temporary chairman), Sir Edward Appleton, Prof. P. M. S. Blackett, Mr. Geoffrey Crowther, Sir Alfred Egerton and Sir George Nelson.

Engineers' Study Group on Economics

Sir Richard Paget, retiring president of the Engineers' Study Group on Economics, at the annual general meeting held on December 1, announced that Sir John Boyd Orr will be president for the coming year, with Sir Geoffrey Bracken (formerly finance minister to the Madras Presidency) as deputy president. Sir Richard outlined some tasks that the Group might undertake. There is still an urgent need for the clarifying of public opinion throughout the world on the true role of money and as to the principles by which all nations should be guided in providing their national currencies and exchanging their surplus products for the common good of the world at large. Gold—a valuable metal—which could be profitably employed in making glorious and everlasting works of art for the admiration and delight of posterity, still lies buried in vaults. The problem of 'the role of money' might be made the subject of an impartial investigation by a team of economists and financial experts from many countries, similar to the teams of workers who, during the War, successfully attacked many scientific problems.

Sir Richard Paget further stated that the Ethics Section of the Engineers' Study Group, together with the Religious and Scientific Research Group, are paying special attention to developing an international ethical system, a code to which men and women of all nationalities, and all creeds, could agree. A stable world will need stable ethical foundations, fearlessly built on the rock of ascertainable truth—on fact rather than on faith.

Shirley Fellowship Awards

The British Cotton Industry Research Association has awarded the first two Shirley Fellowships for postgraduate research to Mr. F. Brown and Mr. T. G. Halsall, both of the University of Manchester, who will work on carbohydrate chemistry under the direction of Prof. E. L. Hirst. Mr. Brown has been working on chromatographic and other methods for the separation of closely related carbohydrate derivatives, and Mr. Halsall has been studying the action of periodate ions on polysaccharides. The new methods of end-group determination thus developed will be applied to problems in the chemistry of starch and cellulose. The fellowships date from January 1, 1946.

Acoustic Control in the Flight of Bats

At the discussion following Prof. H. Hartridge's paper on "Acoustic Control in the Flight of Bats" ecently read before the Linnean Society (*Nature*, 56, 490; 1945), Mr. A. J. Wilmott reported that when he was a child there was in Cambridge a well-known blind organist who was accustomed to walk about the town without the usual aids. When asked how he did it, he replied that the echoes, for example, rom a brick wall, or from a low wall with railings above, appeared to him to be very different. By recognizing the different types of echo he could tell what was near him, and thus locate where he was. This acute sense of hearing even extended to the recognition—at just over two paces—of four ladies who in curiosity to see what would happen stood quite still right across the pavement in the organist's way. The organist hesitated a pace and then came to a complete stop. One of the ladies laughed; thereupon she was instantly recognized by the organist, who said, "I thought there was somebody there". This appears to show that sounds of ordinary frequencies have actually been used by man in much the same way as supersonic sounds are used by bats. (See also p. 692 of this issue.)

Royal Asiatic Society of Bengal

In celebration of the bicentenary of the birth of Sir William Jones, its founder and first president, in January 1946, the Royal Asiatic Society of Bengal is arranging a Conference on Indology and Oriental Culture in the first week of January, and terminating with a banquet on the Foundation Day, January 15. Representatives of learned societies in India, China, U.S.S.R., Iran, Turkey, Great Britain and the United States, as well as individual leaders and patrons of learning, have been invited to participate in the celebrations. A booklet issued by the Society outlines the programme of special publications which has been undertaken in connexion with the bicentenary and includes the address given to the Society by Dr. L. L. Fermor on its one hundred and fiftieth anniversary in January 1934, together with Sir John Anderson's speech on the same occasion, and a list of exhibits at the conversazione. The special publications now projected include a new series of monographs to which Dr. S. K. Mitra is contributing one on the upper atmosphere; a complete author- and subject-index of all the important articles in the Asiatic *Researches* and the *Journal* and *Proceedings* of the Society up to the end of 1945; and a commemoration volume to which Dr. S. L. Hora, Dr. K. P. Brocias and Dr. K. N. Bagchi have been invited to contribute an article on the progress of scientific studies in India.

Atomic Energy and its Implications

A joint meeting of the American Philosophical Society and the U.S. National Academy of Sciences to discuss "Atomic Energy and its Implications" was held in Philadelphia during November 16–17. The following papers were read: Prof. H. De Wolf Smyth, "The Scientific Background of the Atomic Bomb"; Prof. J. R. Oppenheimer, "Atomic Weapons"; Prof. R. S. Stone, "The Health Protection Activities on the Plutonium Project"; Dr. J. H. Willits, "The Process of Social Adjustment to Atomic Energy"; Prof. J. Viner, "Implications of Atomic Bomb for International Relations"; Dr. Irving Langmuir, "World Control of Atomic Energy"; Prof. J. T. Shotwell, "The Control of Atomic Energy under the Charter". The Franklin Medal Lecture, on "Atomic Energy as a Human Asset", was delivered by Dr. Arthur H. Compton.

Announcements

Dr. E. S. Russell has retired from the post of director of fishery investigations in the Ministry of Agriculture and Fisheries, but will continue to serve for some time in an advisory capacity.

Mr. R. R. Enfield has been appointed to a new post of chief economic adviser to the Ministry of Agriculture and Fisheries from December 4. Mr. D. A. E. Harkness, senior assistant secretary in the Ministry of Agriculture, Northern Ireland, has been appointed from the same date to succeed Mr. Enfield as principal assistant secretary in charge of the Economics and Statistics Division of the Ministry.

Prof. W. Weisbach, writing from Langeraar (Z.H.) A.95, Holland, states that he has now returned from German concentration camps, and is the sole owner of the publishing house of his partner and father-in-law, Dr. W. Junk, who died in 1942. *Tabulæ Biologicæ*, *Enzymologia*, *Mycopathologia*, etc., will be published as usual again in due course by the firm.

Dr. John R. Campbell, scientific officer on the staff of the Fuel Research Division of the Department of Scientific and Industrial Research, has been appointed lecturer in fuels at the Royal Technical College, Glasgow, in succession to Dr. G. S. Cruickshanks, who has retired.

The Royal Society of South Africa has elected the following as fellows: Dr. A. J. Boyazoglu, for outstanding work on agricultural problems including rural economic surveys in various lands; and Commander B. L. Goodlet, for many-sided researches in electrical engineering both in peace-time and in association with the Royal Navy.

The following appointments, promotions and transfers in the Colonial Service have recently been made: J. D. Hunter-Smith, to be agricultural officer, Tanganyika; G. E. M. Latimer, to be veterinary officer, Nigeria; J. P. Bernacca, to be entomologist, Uganda; E. G. N. Greaves, to be deputy Government chemist, Trinidad; Dr. E. Phillis, to be chief scientific officer, Department of Agriculture, Trinidad; D. Thornton (agricultural officer, Tanganyika), to be senior agricultural officer (soil erosion), Tanganyika; F. W. Toovey (botanist, Nigeria), to be senior botanist, Nigeria; J. A. N. Burra (assistant conservator of forests, Gold Coast), to be assistant conservator of forests, Palestine; W. J. Eggeling (senior assistant conservator of forests, Uganda), to be conservator of forests, Uganda; W. A. Fairburn (senior assistant conservator of forests, Nigeria), to be conservator of forests, Nigeria; C. B. Bissett (senior geologist, Uganda), to be deputy director of the Geological Survey, Uganda; T. Hirst (senior geologist, Gold Coast), to be deputy director of the Geological Survey, Gold Coast.

Erratum.—The British publishers of the book "Patrick Geddes" reviewed in *Nature* of November 24, p. 612, are the Oxford University Press, Amen House, Warwick Square, London, E.C.4, and not Messrs. Chapman and Hall, Ltd., as stated.

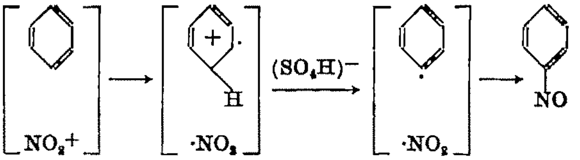
LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Univalent Electron Transfers in Aromatic Nitration?

We have been studying the kinetics of aromatic nitration on the lines indicated in a prefatory publication[1], and in consequence have an opinion to offer on the question indicated by the title, which has been raised more than once recently, notably in an interesting article by Kenner[2].

Any process of co-ordination between an atom with an unshared electron pair and another with an open sextet can conceptually be dissected into a univalent electron transfer and a succeeding homopolar union. It has not hitherto been usual to assume such a stepwise mechanism in the absence of some evidence of dimerization or other characteristic reaction of the radicals which would be formed intermediately. However, Kenner has proposed a representation which suggests that this evidential requirement can be obviated by supposing the radicals throughout their life to remain "within the sphere of each other's action". His nitration mechanism is expressed, for the nitration of benzene in the presence of sulphuric acid, in the following approximate manner (the brackets indicate 'spheres of action'):



Whereas Kenner's ideas undoubtedly have important applications, we think that, in this particular case, the assumption which might have accounted for the general absence of radical dimerization in aromatic nitration does not in fact provide a simple and entirely satisfactory escape from this and similar difficulties. The above scheme depicts three molecular encounters, and requires the nitrating agent to exist as nitrogen dioxide from the first to the third, that is, throughout the period in which the bisulphate ion and aromatic cation are finding, and reacting with, each other. The nitrogen dioxide molecule must be assumed to remain, during this kinetic transaction, continually within the 'sphere of action' of the aromatic molecule, though presumably bound therein by van der Waals forces only. This is not an easy assumption; and since the physical theory of such forces shows that they never exclude, or greatly interfere with, each other, one is caused to wonder why the nitrogen dioxide is prevented from being also within the 'sphere of action' of the solvent sulphuric acid, to which it will also be bound by van der Waals forces, and with which introduced nitrogen dioxide reacts to give products that are not formed under normal nitration conditions.

Our kinetic work does not suggest that the attack of a nitrating agent derived from nitric acid on an aromatic ring in liquid-phase nitration is ever anything but simply co-ordinative and heterolytic, as would be illustrated by telescoping Kenner's three steps completely, or at least so extensively as to render the step-wise representation an unsatisfactory approximation. The complete mechanism of this electrophilic substitution, including the preliminary formation of the nitronium ion, may, however, b 'unimolecular' or 'bimolecular', with appropriat kinetic differences[1], according as the heterolysis o the nitric acid molecule to yield the nitronium io NO_2^+ is rate-determining or not. The kinetics show that the unimolecular step which can become rate determining is a reaction of the nitric acid, and nc of the solvent (as we once thought) or the aromati substance; and, since it is too slow to be explaine as heterolysis of an OH-group (proton transfer), i must be interpreted as the heterolysis of an NO-bond necessarily to form nitronium ion.

It is by no means implied that univalent electro transfers[3], homopolar unions, and homolyses[4] neve play any part in nitration. We think our kineti results show that they have a role in nitrations by, or with the catalytic help of, nitrous acid. But it i probably relevant that nitrous acid can introduc odd-electron molecules into the system, notably nitrogen dioxide. All these matters will be mor fully discussed elsewhere.

G. A. Benford. C. K. Ingold.
C. A. Bunton. G. J. Minkoff.
E. S. Halberstadt. R. I. Reed.
E. D. Hughes.

Sir William Ramsay and
Ralph Forster Laboratories,
University College, London.
Oct. 11.

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[1] *J. Chem. Soc.*, 929 (1938).

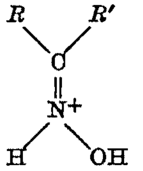
[2] *Nature*, 156, 369 (1945).

[3] Cf. Weiss, *Nature*, 147, 512 (1941); *Trans. Faraday Soc.*, 37, 780 (1941); *J. Chem. Soc.*, 245 (1942); 468 (1943).

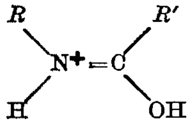
[4] Hey and Waters, *Chem. Rev.*, 21, 169 (1937). Hey, *Nature*, 156, 36 (1945).

Mechanism of the Beckmann Rearrangement

Higman[1] recently suggested a new mechanism for the Beckmann rearrangement, which postulates that the cation (I) rearranges by rotation of the central $>C=N<$ unit through 90° to form (II). This suggestion, though ingenious, is not in accordance with the known facts.



(I)



(II)

The rearrangement of the toluenesulphonates[2] and picryl ethers[3] of ketoximes to derivatives of amides is not prototropic and proceeds by separation of the potential anion attached to nitrogen. The evidence on the latter point is quite unambiguous. The reaction is much faster in solvents of higher dielectric constant; electron-repelling groups (*R*,*R'*) accelerate the reaction, although such groups in other rearrangements (for example, pinacol-pinacoline) have a lower 'migratory aptitude'; the 2:4-dinitrophenyl ethers do not rearrange, though the picryl ethers do so readily. None of these effects would be expected on the basis of Higman's mechanism.

For the acid-catalysed Beckmann rearrangement equally definite evidence is available, and here the proton probably attacks oxygen and not nitrogen.

odskiĭ and Miklukhin[4] have shown that when nzophenone oxime is rearranged in aqueous hydroloric acid enriched with H_2O^{18}, complete exchange oxygen with solvent takes place. Benzanilide changes none of its oxygen under these conditions. erefore the oxygen atom in the resulting benzilide molecule is not the same one that was present the oxime. This is incompatible with Higman's echanism, unless a highly improbable oxygen exange takes place in the oxime itself. Such an change would involve inversion of configuration d formation of mixed amides, neither of which is served under the operative conditions.

All the known facts are well interpreted in terms the ionization mechanism which was lucidly set rth in the article[5] to which Higman referred. It difficult to see why that theory should now be ought unacceptable, and in point of fact no criticm of it has been advanced.

M. J. S. DEWAR.

Dyson Perrins Laboratory,
University, Oxford.

Yature, 156, 242 (1945).
Kuhara and Todo, *Mem. Coll. Sci. Kyoto Imp. Univ.*, 2, 387 (1910).
hapman and Howis, *J. Chem. Soc.*, 806 (1933). Chapman, *ibid.*, 1550 (1934) Chapman and Fidler, *ibid.*, 448 (1936).
Brodskiĭ and Miklukhin, *C.R. Acad. Sci. U.S.S.R.*, 32, 558 (1941); *J. Chem. Phys.*, 11, 342 (1943).
Brynmor Jones, *Chem. Rev.*, 35, 335 (1944).

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orphyrin Fluorescence in the Livers of ellagrins in Relation to Ultra-Violet Light

THE examination, by ultra-violet fluorescence icroscopy, of frozen sections of fragments of livers emoved by an improved biopsy procedure[1] from wenty African pellagrins, soon after admission to ospital, revealed the presence in eight cases of an ntense scarlet red fluorescence. This fluorescence was calized to the hepatic cells, and, when severe, could volve the entire lobule. When the fluorescent aterial was dissolved in the fat droplets in the epatic cells, these assumed an intense crimson colour.

In serial biopsies at weekly intervals of livers of hese eight pellagrins maintained on a carbohydrate itamin-poor diet, it was seen that this fluorescence isappeared first from the central zone and last from he periportal region of the lobules. In so doing, all radations of colours from red to yellowish-brown ackground fluorescence, previously described[2], were bserved.

Oxidized cytochrome, bilicyanin and porphyrins re, so far as we know, the only likely substances in nimal tissue said to give a red fluorescence[3]. We re satisfied that the scarlet fluorescence in the livers f pellagrins is not oxidized cytochrome or bilicyanin or the following reasons: (1) We obtained no uorescence in concentrated solutions of oxidized ytochrome prepared from beef heart by the method f Keilin and Hartree[4]. (2) Bilicyanin prepared by dding an alcoholic solution of zinc sulphate and dine to an alcoholic solution of bilirubin gives a ellow-red fluorescence which is rapidly changed to ellow-green on the addition of alkalis and, simulaneously, the spectroscopic bands characteristic of holetelin make their appearance. (3) The red uorescence of the livers of pellagrins is intensified y acids and alkalis. It is soluble in water and we ave found it, in this respect, to react in a manner entical to dilute solutions of protoporphyrin and he red fluorescence we observed in a liver obtained from a case of severe porphyria in a woman seen in the acute stages of the disease.

Unfortunately, the core of liver tissue obtained from pellagrins was too small to allow for the extraction of porphyrin for spectroscopic identification. The porphyrin fluorescence in the pellagrous livers was invariably associated with evidence of active formation of cytolipochrome and cytosiderin. The iron in some of these livers may amount to as much as 5 per cent of dry weight of liver[5]. The transitory character of the scarlet fluorescence appearing in the acute phases of the disease can easily account for the presence of masses of iron pigment so constantly present in the livers of pellagrins[5,6,7] without any visible porphyrin fluorescence.

The association of scarlet fluorescence and iron pigment is further evidence in support of our view that cytosiderosis of the livers of adult pellagrins is an expression of the disruption of an iron porphyrin complex within the liver cell.

Three pellagrins who had lost their porphyrin fluorescence while on a carbohydrate vitamin-poor diet were afterwards exposed to ultra-violet light for ten minutes on five consecutive days. When biopsy was performed on the sixth day, a marked recrudescence in the fluorescence was noted in the livers of all cases, and in two it was even more intense than on the day of admission to hospital; there was no aggravation of the skin lesions or of the systemic reactions generally seen in this disease. Traces of porphyrins were found in the urine of only one of these cases. Examination of the liver of a healthy patient, admitted to hospital for a minor surgical injury, before and after treatment with ultra-violet light under conditions identical to those provided for the pellagrins, revealed the absence of visible scarlet fluorescence.

From these studies we conclude: (1) Porphyrin fluorescence in the liver can occur during the acute phases of pellagra. (2) The great accumulation of iron pigment in many livers of adult African pellagrins is probably caused by the disruption of an intracellular iron porphyrin complex, such as catalase and cytochrome, present normally in the liver cell. (3) Treatment with vitamin B complex is not required to resolve the porphyrin fluorescence in the livers of pellagrins while on a carbohydrate vitamin-poor diet. (4) Ultra-violet light can excite a recrudescence of the porphyrin fluorescence in the liver without causing an exacerbation of the other external manifestations of the disease. Massive quantities of porphyrins can appear in the liver cells without any detectable amounts in the urine. (5) These experiments emphasize the close inter-relationship between the reactivity of the skin to ultra-violet light and the deposition of iron and the appearance of porphyrin fluorescence in the liver in African pellagrins.

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T. GILLMAN.
S. BRENNER.

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Acetylphosphatase in Animal Tissues

IN the course of experiments on the metabolism of acetylphosphate in rats, an enzyme which catalyses the hydrolysis of this substrate was found. The enzyme is present in homogenates as well as in cell-free extracts of liver, muscle, kidney, brain, but not in blood serum. Acetylphosphate $M/20$ (prepared according to Lipmann and Tuttle[1]) was incubated with liver homogenate and sodium bicarbonate buffer (pH 7·3) at 38° C. More than 80 per cent cleavage was observed in five minutes, and total cleavage was obtained in fifteen minutes. The spontaneous cleavage of acetylphosphate in the same conditions but in the absence of liver was 33 per cent in 180 minutes. The enzyme activity was found to be of the same order of magnitude in extracts of liver, kidney, brain and muscle.

Some properties of the enzyme are described below. The experiments were conducted at 25° C. in order to slow up the action. The hydrolysis was followed (*a*) by estimation of the amounts of inorganic phosphate liberated, using the method of Lipmann and Tuttle[2], (*b*) volumetrically in terms of carbon dioxide formed in the presence of sodium bicarbonate, due to the liberation of acid equivalents during cleavage.

The activity of the extracts was completely destroyed by boiling for five minutes. Acetylphosphatase is relatively resistant to fluoride poisoning. No inhibition was observed with concentrations of $M/100$ sodium fluoride. $M/20$ sodium fluoride retarded the hydrolysis by 50 per cent (as measured by the amount of substrate hydrolysed after fifteen minutes). Sodium cyanide failed altogether to influence the enzyme activity even at concentrations of $M/10$. On the other hand, inorganic phosphate is strongly inhibiting. Inorganic phosphate appears to compete with acetylphosphate for the enzyme: thus, at a substrate concentration of $M/100$, a concentration of $M/30$ inorganic phosphate caused complete inhibition, whereas at $M/20$ substrate concentration an inhibition of only 60 per cent was obtained. Enzyme activity at this substrate concentration is completely annulled by $M/10$ inorganic phosphate, the hydrolysis proceeding at the same rate as in the absence of enzyme.

The non-identity of acetylphosphatase with ordinary 'alkaline' phosphatase is shown by the different distribution of these enzymes in organs and their different behaviour with poisons. The presence of a highly active acetylphosphatase in animal tissues suggests an explanation for negative results obtained with the use of this substrate for phosphate transfer[3] and acetylation[4] in animal tissues. It seems probable that when acetylphosphate is added to animal tissues it is removed by hydrolysis before its possible action as a phosphate or acetyl donor can become manifest. When acetylphosphate appears as an intermediate in metabolism, it is probably maintained in an adequate steady-state concentration within the tissue because the action of acetylphosphatase in these conditions is retarded by inorganic phosphate.

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An Attempt to Obtain Nuclear Excitati by Means of X-Rays

WHEN a substance is irradiated with γ-rays of energy less than that necessary for disintegrati of the nuclei (for most of the elements about 8 MeV only a nuclear excitation can take place. If rad activity is obtained by such an irradiation, it necessary to assume the existence of isome metastable states to which the nuclei have be excited and from which transitions to the groun level take place by emission of (highly converte γ-rays. Experiments in this direction were perform in 1939 by Pontecorvo[1] and Collins[2]. They succeed in activating indium by means of X-rays with energy of more than 1 MeV. By direct irradiation eleven elements, Trumpy[3] later claimed to have asce tained the existence of thirty-five new isomer nuclei with characteristic half-life periods. By varyi the tube voltage from 300 to 1,800 kV., Trumpy w able to determine the critical excitation energy wi an accuracy of 10 per cent. The values we surprisingly low and in fourteen cases less tha 0·4 MeV.

With an X-ray tube supplied from a high-tensi equipment for a 400 kV. maximum, I have irradiate aluminium, copper, rhodium, silver, cadmium, indiun tin, gold and lead. As the radiation emitted by th transition to the ground-level must be assumed to b rather weak, the counters are made of the eleme which is under investigation. In some cases, howeve the substances (in the form of thick foils) have bee investigated inside a specially constructed count where the radiation from the active substance is onl absorbed by the gas in the counter chamber.

The X-ray tube has worked at 390 kV. (max.) wit a tube current of 5 mA. (max.). The anti-cathod is of tungsten and in the shape of a disk, so tha about half the current is reflected backwards.

On the irradiation of copper, rhodium, cadmiun indium, tin, gold and lead, activity has in no cas been observed. With a Geiger-Müller tube of aluminiu made four years ago, a weak effect of the same orde of magnitude as the zero effect was observed, th activity decreasing with a half-life period of abou 2–3 min. Freshly made tubes or foils of aluminiu do not show this effect. A Geiger-Müller tube o glass with a cathode of silver also showed a wea activity of the same intensity as the aluminium tube

The negative result with rhodium is especiall interesting as the nucleus ^{103}Rh is excited by irradiation with fast neutrons[4] to an isomeric state of th stable nucleus and situated only 19 kV. above th ground-level. For such an element, according to ou present conception of the formation of isomeri nuclei by high-voltage X-rays, the activation level might be expected to be situated nearer the ground level than is the case when the lowest metastabl state lies, for example, 200 kV. above the ground level.

At the present stage, when the voltage of the tub cannot be increased, it can only be said that, wit the intensity and energy of the X-ray quanta use here, no activation levels can be found in the element named above. As pointed out by Wiedenbeck[5] an Northrup *et al.*[6] special care must be taken in investigations with irradiated Geiger-Müller tubes Sherrer[7] has shown that in special circumstance field emission of electrons can take place from th Geiger-Müller tube cathode surface, thus falsifyin an induced activity. It seems probable to me tha e excitation levels with low energy ($<$ 400 keV.) und by Trumpy may be of such non-nuclear origin.

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se of Growth-Promoting Substances in he Prevention of Apple Drop following Frost

EXPERIMENTS both in the United States and at ong Ashton Research Station have shown that cer-in substances, when suitably compounded and pplied, will induce the parthenocarpic development f the tomato and other fruits. These fruits are, of urse, seedless. The banana, Washington Navel range, and seedless grapefruit are examples of fruits hich are naturally parthenocarpically produced. nce, in Nature, some fruits may be found which re seedless, it follows that, given an understanding f the natural process, it should be possible to pro-uce seedless fruits of almost any species. This has, n fact, now become an established commercial prac-ice in the tomato. The materials and methods em-loyed in Britain have already been published[1].

Similar experiments with apples and pears were arried out at Long Ashton in 1943 and 1944 and y other workers in the United States, but without uccess. At Long Ashton, certain compounds were artially effective in that they did cause the fruit o remain on the trees until July, when they fell off.

The severe frost of April 30–May 1, 1945, when ost of the apple blossom had set and the fruitlets ere already beginning to grow, killed the embryos nd blackened the centres of all fruits. This provided unique opportunity to try a number of compounds elected after recent experience with tomatoes.

Two varieties of apple were selected for trial, amely, Miller's Seedling and Cox's Orange Pippin, oth about eighteen years old and carrying a heavy et of fruit. Six trees in each row were sprayed ith a wash containing beta indole butyric acid, lpha naphthalene acetic acid, 2–4 dichloro phenoxy cetic acid and beta naphthoxy acetic acid at 5, 5, 5 nd 60 p.p.m. respectively, making a total hormone oncentration of 75 p.p.m. The choice of these aterials and concentrations was based upon a wide xperience of their use in the production of partheno-arpy in the tomato.

The wash was applied by a power sprayer using a ressure of 400 lb./sq. in. The day was reasonably alm, and each tree was thoroughly drenched with bout ten gallons of wash per tree.

The results were spectacular. Within fourteen ays almost every fruit had fallen from the unsprayed trees of Miller's Seedling, whereas none had llen from the sprayed trees. Furthermore, these uitlets had begun to swell. The spray also caused a onsiderable amount of leaf epinasty.

In contrast to the above effect upon Miller's Seedling, the spray had no effect whatsoever upon Cox's Orange Pippin. There was not even epinasty of the foliage and every fruit fell.

Observations were continued throughout the summer of 1945. By July 14 practically every fruit had fallen from the unsprayed trees of Miller's Seedling, but the fruits were literally clustered on the treated trees. Many of these fruits had grown to about a quarter normal size, but had ceased further development, so it was decided to thin some of these trees. During this operation it was found that the fruit tended to break away from the spur anywhere along the fruit-stalk rather than at the abscission layer, which was very firm indeed. By this date most of the fruits were about 1¼ in. in diameter and were noticeably sweet and juicy.

Final observations were made on August 14 when the crop was picked except for two trees which were left as specimens. By this date the fruit was fully ripe and ready to harvest, but showed no tendency to drop even when the trees were shaken vigorously, whereas the few fruits which remained on the control trees had started to drop.

The effect of the treatments is shown in the accompanying table.

MEANS PER TREE (MILLER'S SEEDLING)

	Weight in lb.	No. of fruits more than 2 in. in diameter	No. of fruits 1¼–2 in. diameter	No. of fruits less than 1¼ in. in diameter
Treated :				
Unthinned	169	13	621	9,486
Thinned	60	30	325	2,025
Control	17	29	88	443

The extraordinary effect of the spray in keeping the fruit on the trees is shown by the fact that the unthinned trees had an average of 9,486 fruits per tree. Because of war-time difficulties it was not possible to thin these trees early enough to produce any really advantageous effects; but even when thinned as late as July 14, the effect is seen in the number of fruits which were graded 1¼ in.–2 in. diameter.

So far as I am aware, this is the first time that any success has been obtained in preventing the fall of deciduous fruit by means of growth-promoting substances. It is admitted that the result is not at present of immediate practical or economic importance; but it is now only a matter of time before suitable materials and methods will be evolved for this purpose.

The complexity of the problem is indicated by the fact that materials which proved highly effective on Miller's Seedling were without any effect upon Cox's Orange Pippin. The specific nature of many of the growth-promoting substances is, of course, well known, and this serves as a particularly good example.

This preliminary trial has also revealed certain points of practical importance. The amounts of substances used were undoubtedly excessive, and in our endeavour to get a complete cover we used too much wash per tree. This is indicated by the fact that the 'buffer' trees which received only the spray drift set a fair crop and neither the foliage nor growth was adversely affected. The heavy application of the growth hormone mixture to the Miller's Seedling trees suppressed the 1945 extension shoot growth, so that these trees had a much lower leaf area during the 1945 growing season than had the control trees. This suppression of shoot growth is in itself an undesirable effect, and in these trees may cause a lowered flower production both in 1946 and 1947.

Since this trial was initiated, other substances have been brought to my notice, and these may be even more effective on apples and pears than the ones used above. Furthermore, the success obtained with tomato flower extract and animal sex hormones as recently reported by me[2] offers still further scope for development along these lines.

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Oct. 9.

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[1] Swarbrick, T., Rep. Agric. Hort. Res. Station, Bristol, for 1944, 36 (1945).

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Accumulation of Sugars in Barley Seedlings on Very Acid Soil

FOR a number of years it has been noticed at Woburn that seedling barley plants sown in soil too acid to allow normal growth (*p*H 4·3 or thereabouts) were very much more attractive to small birds (chaffinches and the like) than similar seedlings grown on a normal soil (*p*H 6·0–6·5); and that consequently a very large proportion of the growing seedlings were dug up and the seeds eaten when little or no similar damage was done to plants on normal soil. At first the tendency was to attribute the difference to the slowness of growth on the acid soil, which kept the seedlings in a condition suitable for bird attack for a much longer period, but this explanation failed when it was found that the seedlings were attacked almost as soon as the shoots appeared above the ground.

It seemed certain that the seedlings on the very acid soil contained something which made them more attractive to birds, and it was suggested that there might be an accumulation of sugars which made them much sweeter than normal plants at the same stage of growth. We have now examined on several occasions seedlings from both types of soil, grown on trays under similar conditions to the point when the second leaf was just visible, when they are still quite attractive to birds. This stage was reached with normal soil in 11–15 days, and with the very acid soil in 19–21 days. The plants were then pulled up in the morning, the fibrous roots cut off, the seeds and the tops separated from one another and the total sugars soluble in alcohol determined with Fehling's solution after inversion with acid.

The results obtained in two separate experiments are shown below, the percentages being on the dry matter of the tops or the seeds.

GLUCOSE EQUIVALENT OF TOTAL SUGARS

	Normal soil (*p*H 6·5)		Very acid soil (*p*H 4·2)	
	Tops	Seeds	Tops	Seeds
a	5 3 per cent	26·8 per cent	24·1 per cent	42·6 per cent
b	7·2 ,,	21·1 ,,	29·7 ,,	30·6 ,,

It is clear, therefore, that there tends to be an accumulation of sugar both in the tops and in the seeds where the seedlings are grown on very acid soil, probably due to the feeble growth of the seedlings after germination has taken place.

The cause of the attractiveness to the birds is still better shown if the figures are given as sugar (that is, glucose equivalent) per 100 tops or seeds. These are as follows:

GLUCOSE EQUIVALENT OF TOTAL SUGARS PER 100 TOPS OR S

	Normal soil (*p*H 6·5)		Very acid soil (*p*H 4·	
	Tops	Seeds	Tops	Seed
a	56 mgm.	457 mgm.	178 mgm.	984
b	59 ,,	348 ,,	298 ,,	700

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Aug. 15.

Acoustic Control in the Flight of Bat

PROF. HARTRIDGE has suggested[1] a compari between radar and acoustic range- and directi finding in bats. He suggests that the interrup supersonic note may be used to measure the ra to obstacles. The note emitted lasts about 0·01 During this time the first waves of the sound travel about 10 ft. To determine range with accuracy either the onset (leading edge) or the end (trailing edge) of the echo must be used as a pc of reference.

If it is assumed that a bat, like a radar set, u the leading edge of the echo to judge range, the le range which it could perceive would be consideral In a radar equipment with a 1 µsec. pulse the lead edge of the echo from an object at less than metres from the aerials will be received during period of transmission and therefore lost. For a there will be a similar range blind to the leading e of about 5 ft. It is possible that the bat uses trailing edge of the echo, however. In these circu stances there will be no well-defined lower limit range measurement. One function of the comp intra-aural muscle reflex may be to make use of trailing edge, for without this the reflected n from close objects would appear to the bat as c tinuous with the emitted one. In natural conditic the eyes no doubt also assist in perceiving n objects.

The maximum range at which an object can detected may also be limited. In an airborne rac equipment which is so designed that the outgoi signals are not beamed, the maximum range at wh an aircraft can be detected is equal to the heig of the radar equipment. This is because the sign reflected from the ground tend to swamp all othe It is possible that the bat overcomes this difficul by the great development of the pinnæ of the ea which may allow it to hear only echoes from obje directly ahead.

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Nov. 4.

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[1] Hartridge, H., *Nature*, 156, 490 (1945).

DR. EWER has raised an interesting point w regard to bats' hearing which I have been trying elucidate. We have been approaching the mat from somewhat different points of view. There very strong evidence that bats are aware of obstac ahead of them not only when they are several met away, but also when they are quite close. Th during my experiments in King's College in 19 these animals were observed to fly quickly throu an open doorway from one room to another. the intervening door was gradually closed to hes, fewer passed through and there was a good al of fluttering before the passage was negotiated. the door was closed to four inches, the bats would it were come up and look and then fly off again thout attempting to pass. This experiment was eated with all lights extinguished, and it was found at many bats negotiated the six-inch opening ough always with much audible fluttering; larger enings than this they swooped through without ncern. This fact was found by closing the light itch suddenly and catching one on the point of tering or emerging."

Galambos and Griffin, who investigated the cries bats with a supersonic detector, reported that "the personic cry lasts no more than 0·02 second on e records, and there is good reason to believe that ertial factors in the recording device introduce rors into this estimate. The cry probably lasts no ore than 0·01 second." Now it is clear, if this timate be correct, that a bat two metres away from reflecting object should be able to hear the whole the echo without any interference from the sound hich it is emitting from its larynx. As it flies towards e object, however, more and more of the echo incides with the period of sound emission, thus terfering with the hearing of the echo. There are ree possible ways of avoiding this difficulty: to ake use of the Doppler effect, to shorten the period f sound production and to screen the ears from the urce of sound. With regard to the first way, a at flying at 3 metres per second towards an object ould hear an echo exceeding the pitch of its voice y about one fifth tone. The human ear would be ble to identify this change of pitch; but it is very oubtful whether it would be able to detect the xistence of such an echo when a strong voice tone as present at the same time. A similar statement may e made about a bat. But an even more important oint is that when a bat slows up, and starts to flutter, s it approaches an obstacle, the Doppler effect disappears and the echo more and more resembles the oice tone in pitch.

It has been shown by Galambos and Griffin that the umber of supersonic cries made by a bat depends n where it is and what it is doing. A resting bat sually produces 5–10 cries per sec. When it begins fly, the number increases to 20–30. When it is pproaching an obstacle it may produce 50–60 per c. But as soon as it has passed the obstacle, the umber drops abruptly to 20–30 again. Now it is ossible, as the number of cries per second is increased, at the duration of each cry is correspondingly duced. If such were the case, then overlap between e echo and the voice might be avoided as an bstacle is approached. The following table shows r different distances the maximum duration of the y if overlap is to be avoided.

Distance	Duration (0·001 sec.)
200 cm.	12
100 ,,	6
50 ,,	3
25 ,,	1·5
16 ,,	1

uch short durations are not impossible in view of alambos and Griffin's statements concerning their upersonic detector.

With regard to the screening of the ears from the oice tone, I am told that bats can be divided into wo groups: those with flat snouts and normal ears, nd those with the usual pointed snout but having a ecially developed cartilage, the tragus, in front of the external auditory meatus. The flat snout, by directing most of the supersonic energy in a forward direction, may screen the ears and thus enable them to pick up faint echoes. The tragus in the other group of bats may have the function of screening the ears from the direct voice tone while it permits the entrance of reflected sounds.

With regard to Dr. Ewer's suggestion that it may be the trailing edge of echo which the bat uses for localizing purposes, I think it is more likely to be the leading edge that is used because the former is liable to be masked by sounds reflected by other objects in the vicinity. It is quite possible that the bat uses both leading and trailing edges of the echo for localizing purposes.

H. Hartridge.

WITH reference to the interesting article on bats by Prof. H. Hartridge in *Nature* of October 27, p. 490, I venture to submit certain observations made by a group of observers without professional scientific qualifications but with some theoretical and practical knowledge of aviation. The group in question consisted of three pilots and two gunners at a Royal Air Force camp in Italy. Our admiration was roused by the performance of a large number of bats that infested our camp soon after dark each evening.

Though we had no knowledge of the acoustic control system of bats described by Prof. Hartridge, we soon came to the conclusion that something of the sort must be employed. The room from which we made these observations was a lofty one with a very large area of french windows; when the electric light was on, the glass of these windows was entirely invisible from outside. The bats, apparently attracted by the light, would turn and dive repeatedly at these windows with the obvious intention of passing inside the room. They invariably detected the presence of the glass, however, and never once did they crash into it. This seemed the more remarkable as birds had occasionally been deceived in broad daylight; the open appearance of the room, which was comparatively narrow, with windows on both sides, encouraged them to attempt to swoop right through it, with disastrous results.

Detection seemed to occur about two feet from the glass, which left very little room for avoiding-action. This usually consisted of a steep turn to starboard, but we observed many stalled turns, and, much to our astonishment, half rolls! Since we had all been under the impression the latter manœuvre was unheard of in Nature, we took some trouble to confirm it. As the bat approached to within two feet of the glass, it would fold up its starboard wing, but keep the other extended; the unequal lift turned it on to its back in a flash, whereupon it extended both wings and fell vertically down the surface of the glass at a distance of a few inches, pulling out on a reciprocal course some three or four feet lower down. We confirmed this by watching from inside the glass where, in these cases, we had a clear, though very brief, sight of the bat with its belly and the underside of its wings presented to the glass and its head pointing straight downwards.

I think it possible that anyone making a serious study of a bat's manœuvring ability might find this method of observing at night from behind a brightly illuminated glass barrier extremely useful.

Martin Wilkinson.

Nov. 13.

MEDAL AWARDS OF THE ROYAL SOCIETY

Copley Medal

THE Copley Medal is awarded to Dr. Oswald Theodore Avery, of the Rockefeller Institute of New York, for his contributions to knowledge of the chemical basis of the specific properties of bacteria, particularly of the types of the pneumococcus. His researches in this field have appeared in unhurried and orderly sequence over the course of a long and distinguished career, and they have furnished a large and essential constituent of the framework now available for a fundamental science of immunochemistry.

We allow ourselves to claim Avery as Canadian by birth, though with acknowledgment that his life's work has been accomplished in the United States of America, and in the Rockefeller Institute of New York in particular, of which he has held the membership since 1913.

It was in 1917 that Dochez and Avery demonstrated that cultures of different strains of the pneumococcus yielded different 'soluble specific substances'. From 1923 onwards, appeared a remarkable series of papers by Avery, with Heidelberger and other collaborators, in which it was shown that these specific substances had the nature of complex polysaccharides of highly individual characters. These were present in the regular capsular envelope characteristic of the pneumococcus in its virulent forms ; and each type of such virulent pneumococci, distinguishable by its immunological specificity, was shown to have its own distinct polysaccharide. Each of these reacted, with a like specificity, with the corresponding immune body. Not that these polysaccharides, the soluble specific substances isolated in chemical purity, had antigenic properties by themselves. It was only when they were artificially linked to proteins foreign to the reacting animal body, or retained their natural linkage with proteins of the bacterial strains producing them, that they elicited, on injection, the appearance in the blood of specific immune substances, causing agglutination or lysis of the corresponding organisms ; but, with the immune substances thus evoked, the pure, separated polysaccharides now exhibited the same specific affinities, each forming a precipitate with the corresponding antiserum.

Here, then, in chemically definite form, were separable, prosthetic, combining groups such as Paul Ehrlich had long earlier envisaged and prophetically named 'haptenes'. Here also was one of the principal foundation stones of a great building of immunological chemistry, which, in the hands of Avery's contemporaries and followers, notably in those of a distinguished fellow-member of the Rockefeller Institute, the late Karl Landsteiner, has rapidly included an ever-widening range of studies of artificial and natural antigens.

Meanwhile, in the hands of Avery and his coworkers, knowledge of the specific characters of the pneumococci, and of the manner in which these are acquired, had been moving quietly to a new pinnacle of achievement. They had long ago shown that pneumococci, which, in artificial culture, have lost the capsules endowing them with virulence and containing the specific polysaccharides, have reverted to avirulent non-specific types, growing in the rough, wrinkled colonies characteristic of such defective strains. It had been shown also, by the late F Griffith, that such a degenerate, non-specific pn mococcus, from whatever specific type it had provenance, could be induced by cultivation in medium prepared from a complete, virulent type re-acquire a capsule conferring the correspondi specificity. And now, only last year, Avery, w Macleod and McCarty, has been able to isolate and characterize a chemical principle acting in mini dosage as the specific stimulus to such a transformati An unencapsulated, avirulent, typeless pneumococ derived from a specific strain of type II responds this stimulus by acquiring and retaining the caps and specific polysaccharide, with the virulence a the cultural characters, of a fully specific strain type III. Here surely is a change to which, if were dealing with higher organisms, we should acc the status of a genetic variation ; and the substar inducing it—the gene in solution, one is tempted call it—appears to be a nucleic acid of the desoxy bose type. Whatever it be, it is something whi should be capable of complete description in ter of structural chemistry.

Avery, a veteran now among investigators, h thus, on the eve of his retirement, attained this ne peak of discovery—a fitting climax to a devot career of such wide influence on the progress science.

Royal Medals

A Royal Medal is awarded to Prof. John Desmo Bernal, professor of physics in Birkbeck College, U versity of London, in recognition of his distinguish contributions to the theory and the applications X-ray crystal analysis.

Bernal's first important work in this field, publish in 1926, was a fundamental study of the basis of t interpretation of X-ray rotation photographs single crystals ; and the methods which he th evolved are still in use. He was largely concern with the initiative which led to the construction the "International Crystalline Tables", and hims accepted an important share of the editorial wo required. Later he became a leader in the applicati of X-ray crystallography to the elucidation of t structure of highly complex organic molecul Organic chemists had encountered difficulties, lo insuperable, in formulating a satisfactory structu for the sterols. Here Bernal's crystallographic dat indicating the general shape and dimensional limi of the sterol molecule, supplied a key which open the way to a convincing reconstruction of the pol cyclic framework of cholesterol, ergosterol and cal ferol in the first place, and eventually to the stru tural formulation of a vitally important series gonadal and adrenal hormones, as these, in d course, were isolated and identified. With admirab enterprise he, with his pupils and associates, pr ceeded to apply the methods of X-ray crystall graphy to crystals of some of the simpler protein as these became available, such as crystalline peps and, later, insulin. Then the discovery, by Stanle that a plant virus—that causing the 'mosaic' diseas of tobacco—could be obtained in crystalline for opened the way for Bernal to apply his techniq to elucidate the structure of a protein endowed wi such paradoxical characters. He was able to descri the virus units as long, rod-like structures, 1,500 ength by 150 A. in diameter, and with an inner larity in structure fitting a hexagon lattice and, arently, consisting of cubical sub-units measuring ut 11 A. The readiness with which the long virus ts, in a solution, set themselves parallel in a two- ensional lattice provided an explanation for the ble refraction and other physical properties which h solutions of the virus exhibit.

ust before the War, Bernal had published a pre- inary note on the structures of hæmoglobin and chymotrypsin. Then, like others, he found his ivities diverted to the scientific service of the cial needs of the nation and its allies at war. The e is not yet for detailed mention of the important cial researches he has carried out during the years mediately past, for the Ministry of Civil Defence, Combined Operations Command, and other vice Departments, which have successively made ims on his special knowledge and ability. We are d to know that some of his pupils have been able keep the thread of his more normal scientific tivities unbroken over this interval. Biochemistry, well as the physics of his primary discipline, will pect much now from his resumption of personal rticipation and leadership in a field which he has de so much his own.

A Royal Medal is awarded to Dr. Edward James lisbury, director of the Royal Botanic Gardens, ew, in recognition of his distinguished contributions plant ecology.

Salisbury's work has had a most important influence broadening the basis of the study of British plant mmunities, and in diverting ecological work in eat Britain from an essentially floristic outlook to e in which the habitat and the autecology of in- vidual species have been put in the forefront of terest.

Combining his expert ecological knowledge with a ide acquaintance with cultivated plants and their nditions of growth, Salisbury has shown an ex- ptional capacity for relating horticultural practices known physiological and ecological facts, where more strikingly shown than in his "Living arden". A similar faculty served the country well the earlier part of the War in connexion with his anifold activities on the Agricultural Research ouncil.

Making his first contacts with ecology by a de- iled study of the oak-hornbeam woods of Hertford- ire, to which he brought some of the experience ined by co-operation with F. W. Oliver in the vestigation of the maritime communities at Blake- ey Point, Norfolk, Salisbury soon exhibited a more neralized approach to ecological problems. Ex- mples are furnished by his papers on the calcicolous abit and on leaching, which traverse a wide field nd open up new points of view. Although somewhat ifferent in scope, the investigation on stomatal fre- uency, supported by a very large mass of data and ublished in the *Philosophical Transactions* in 1927, essentially directed to clarifying the ecological icture.

In his presidential address to the Ecological Society 1929 on the biological equipment of species in elation to competition, a topic which is repeatedly ouched upon in his earlier work, attention was irected to the almost complete lack of information on he reproductive efficiency of the different species of lowering plants. This aspect of a species' equipment ad already interested Salisbury for some years, and a number of significant data were given in the course of his address. Despite preoccupation with many other matters, he continued actively to accumulate information on reproductive capacity during the subsequent years, collecting data on the seed production of more than 240 British species, which involved the examination of several hundreds of thousands of individual plants. The numerous important conclusions derived from this comprehensive study, which disposes of several fallacies, were published in 1942 in a book, "The Reproductive Capacity of Plants", which constitutes a landmark in the progress of plant ecology.

In addition to his ecological work, Salisbury is known to his botanical colleagues for earlier work on fossil seeds and for important contributions to the distribution of British plants and to the interpretation of floral morphology.

Davy Medal

The Davy Medal is awarded to Prof. Roger Adams, professor of chemistry in the University of Illinois, in recognition of his distinguished researches in organic chemistry.

Roger Adams is undoubtedly the outstanding organic chemist in the United States at the present time, and his school, the largest and most vigorous of its kind in that country, is of international repute.

His researches, distinguished by great originality and dogged perseverance alike, embrace a remarkably wide field. In a series of brilliant papers he has described the complete elucidation of the structure of gossypol, a highly complex pigment present in cotton seed. This achievement is all the more noteworthy since several other investigators had failed to make much headway in examining this highly sensitive compound. His experimental skill and theoretical insight have, in recent years, led to notable advances in alkaloid chemistry, and in this connexion special mention may be made of his work on the structure of monocrotaline, the toxic constituent of various Crotalaria. Adams has been responsible for pioneering research in attempts to find synthetic substances antagonistic to the leprosy bacillus and other acid-fast bacteria, and this led him to a detailed study of the chemistry of hydnocarpic and chaulmoogric acids. He has contributed notably to our knowledge of the constituents of *Cannabis sativa* and *C. indica* (marihuana and hashish), and he has determined the structure of some of their major physiologically active components. His wide interests are clearly exemplified by his researches on stereochemical problems, particularly of the phenomenon of restricted rotation, where his work, especially with diphenyl derivatives, and more recently with aryl olefines and arylamines, is of fundamental importance. Another indication of his versatility is to be found in his detailed studies of catalytic hydrogenation with noble-metal catalysts; the platinic oxide catalyst which he perfected is now universally employed and is known as Adams's catalyst.

While Adams's researches place him in the first rank of contemporary organic chemists, his share in inaugurating the publication of "Organic Syntheses", and "Organic Reactions", immensely valuable standard works of an original type, has ensured that future generations of chemists will ever remain in his debt.

During the War, Adams's activities have been largely transferred to administrative spheres, where his foresight and organizing ability have enabled him to play an important part in the vast scientific effort of our American colleagues.

Hughes Medal

The Hughes Medal is awarded to Prof. B. F. J. Schonland, director of the Bernard Price Institute of Geophysics, University of the Witwatersrand, in recognition of his important physical studies of atmospheric electricity and thunderstorms.

Schonland's main contributions to physical research have been in the field of atmospheric electricity, and have dealt particularly with the complex series of electric discharges which constitute a 'stroke' of lightning. Although the study of phenomena associated with thunderstorms could be undertaken under especially favourable natural conditions in his native South Africa, it needed enthusiasm and perseverance to overcome the many technical difficulties encountered in a country in which physical research had not yet been greatly developed, and to bring the research to such definite and illuminating conclusions.

Schonland's early work (1927, 1928) dealt with the polarity of thunderclouds; it was established that the negative was below the positive pole of the thundercloud, and that the currents flow in such a direction that they carry negative charges to the earth. Schonland also studied the importance of point discharges (from trees, etc.) in the maintenance of the earth's negative charge. He next used (1934–38) a rotating lens camera of the type devised by the late Sir Charles Boys to photograph and analyse the lightning discharge, and obtained results of great importance for knowledge not only of the nature of the lightning discharge but also of electric discharges in air in a more general sense.

Schonland has taken an active part in the study of cosmic radiation and particularly of the relation between penetrating radiation and thunderstorms; there is a reduction in the intensity of penetrating radiation when thunderclouds are overhead, and this fact provides information as to the total charge carried by penetrating radiation. The occurrence of impulses in a Geiger-Müller counter coincident with discharges in distant thunderstorms shows that some type of penetrating radiation is produced by electrical discharges during thunderstorms. This work on cosmic rays in Schonland's laboratory is of special importance, since few such systematic observations have been continued over long periods in the southern hemisphere.

Schonland has also taken a prominent part in the study of the nature of the 'atmospherics' interfering with wireless transmission, and of the part played by the ionosphere in their structure. These studies have equipped him on the technical side for various military positions he has held during the War; for these, also, his experience in the War of 1914–18 as a captain in the Royal Engineers (Signals) had given him additional equipment. In the War now ended he rose to the charge of an Army Operational Research Group with the rank of brigadier, and later became scientific adviser to the 21st Army Group commanded by Field-Marshal Montgomery; and now General Smuts, as Prime Minister of the Union of South Africa, has claimed Dr. Schonland's services as his adviser on the promotion and development of scientific research in his own country.

BOSE RESEARCH INSTITUTE, CALCUTTA

ANNUAL REPORTS

THE annual report of the governing body of
Bose Research Institute, Calcutta, for the y
1943–44 refers to the way in which the growi
difficulty in securing photographic materials, gl
goods and chemicals, especially organic chemica
hampers the work of the Institute. With gra
received from the Board of Scientific and Industr
Research, schemes of research on the setting up o
powerful generator of ultrasonic waves and
testing and cutting quartz plates for the radio indust
have been undertaken, and with grants from t
Bengal Immunity Co., Ltd., schemes for appli
research in microbiology and on the vernalization
paddy in Bengal are also being undertaken. Amo
the investigations referred to in the report are th
on cosmic rays, and an important paper on t
Wilson chamber study of meson spectra has be
published in the *Transactions* of the Institute, resu
obtained in the laboratory agreeing with the p
dictions of the theory of Moller and Rosenfeld. T
investigations with the Wilson chamber photograp
are being continued to verify and extend the resul
obtained with lead absorbers with other absorbe
like iron and carbon. Other physical researches we
concerned with nuclear fission, the nuclear isomeriz
tion of Br^{80}, the construction of a neutron generat
and an ultrasonic generator. A valve tube amplifi
circuit has been assembled for measuring dielect
potentials set up in plant tissues, either simultaneous
or under stimulation, and the transmission of excit
tion in *Nitella* and *Chara* is being studied.

An important part of the activity of the Bi
chemistry Department is the preparation of biologi
ally active compounds required for physiologic
and microbiological studies of plants, including su
substances as glucose 1-phosphate, adenylic ar
nucleic acids, *cis*- and *trans*-crocetin dimethyl este
crocin and picrocrocin, and it has been possible
isolate *cis*- and *trans*-crocetin dimethyl ester, croc
and saffranol from saffron obtained from Kashmi
the yields of these compounds from the Indian variet
being higher than those obtained by Kuhn ar
Karrer from saffron from Spain, the south of Fran
and Asia Minor. A series of manurial experimen
has been conducted with jute plants, and furth
investigations completed on the effect of the *p*
values of nutrient solutions on the growth of ju
plants.

In the Biology Department preliminary exper
ments on the auxin effect on *Desmodium gyran*
indicate that at low concentrations the auxin is
respiratory catalyst for some substrates present in th
cells of *Desmodium gyrans*, and that malate is one
the substrates on which this auxin acts. Differe
concentrations of synthetic auxin were tried to pr
duce roots in gootes and cuttings of cinchon
indolylbutyric acid being the most effective in th
formation of roots. The study of the growth of th
root is being carried out by an automatic recordin
device previously constructed in the Institute. In th
Microbiology Section, studies of the diseases
tropical fruits and vegetables are being undertake
to discover the nature of the relation between th
parasites and their specific hosts, nature of infectio
and mechanism of rotting, factors influencing th
susceptibility of fruits and control of wastage.

cial retting substance named 'Hiparol' has been covered which is capable of retting jute, coco-nut d other fibrous plants in 8–18 hours instead of the 0 weeks in the natural process. Strains of various cies of *Penicillium* have been isolated and their wth-rates and rates of production of penicillin died in modified Czapek-Dox and other media. ese investigations on penicillin and yeast are being tinued under a grant from the Bengal Immunity ., Ltd.

n the report for the year 1944–45, reference is de to the working out of a theory of the mechanism enzyme action, based on the assumption of differtial catalysis for reversible enzymic processes, d the preliminary, indications on the possible istence of two different phosphorylases in potato ve been confirmed. Other investigations have lated to the chemical transmission of stimulation d the problem of vernalization and the phasic velopment of some Indian crops, including wheat d paddy, and breeding work on cotton. The enzyme mplex, hiparol, is also capable of yielding butanol d acetone when mixed with suitable substrates, d the industrial application of this result is being vestigated. A strain of *P. notatum* isolated from cal garden soil possesses certain advantages over rains imported from abroad. Large-scale production the antibacterial agent is being undertaken; the ude filtrate is being used for surgical dressings on ses of *Staphylococcus* infection with very satisfactory sults.

RECENT CHEMICAL RESEARCH IN THE U.S.S.R.

SEVERAL chemical journals from Soviet Russia have recently been received, and a few of the any interesting papers in them may be briefly entioned.

Kapustinsky[1] has modified his well-known equation r the lattice energy of an ionic crystal by assuming n exponential equation for the repulsion force (Born–Mayer) instead of an inverse power law. The equation hen becomes, in k.cal.mol.$^{-1}$,

$$E = 287{\cdot}2\,\Sigma n\;\frac{z_1 z_2}{r_1 + r_2}\left(1 - \frac{0{\cdot}345}{r_1 + r_2}\right),$$

here Σn is the number of ions in the molecule, $_1$ and z_2 are the valencies, and r_1 and r_2 the radii f the ions. The calculated values are compared with those determined by the Born cycle method nd the discrepancies do not as a rule exceed 1 or per cent. The new equation is only slightly more omplicated than the older one, and comprises the ame variables: it is likely to prove of service in he study of ionic crystals.

Zvektov and Sosnorsky[2], by studying the dielectric roperties of an anisotropic liquid (liquid crystal) n a rotating magnetic field, measuring the torque xerted on the substance, have extended the work f Zvektov[3] to several other liquids. The results rovide a measure of the specific diamagnetic anisoropy, that is, the difference between the susceptiilities parallel to and perpendicular to the axis of ymmetry. It had previously been shown that the ffect is due to the single molecules and not, as was nce assumed, to molecular clusters. The effect is articularly marked in aromatic derivatives, and is n agreement with Pauling's view that in the benzene ing three of the four valency electrons of carbon have orbits in planes uniformly distributed in space while the orbit of the fourth lies in the plane of the ring. The implications of this are fully discussed, and the general assumption that the magnetic anisotropy of the liquid crystals examined is determined by the number of benzene rings in the molecules is, on the whole, substantiated.

The mechanism of the combustion of carbon in oxygen has been studied recently by several investigators. Klibanova and Frank-Kamenetzky[4] point out that the mechanism of reaction at ordinary pressure is quite different from that under very low pressures. It appears that at ordinary pressure at about 600° the surface of carbon in contact with carbon dioxide is covered with a film of surface oxides, CO and CO_2, and oxygen reacts with these much more easily than with a free carbon surface. At very low pressures, these surface oxides are absent. A difficulty in the kinetic measurements is that, in most cases, only the diffusion velocity is measured. In the present experiments, carbon filaments with a smooth deposited layer of crystalline carbon were used. The filament was electrically heated in a current of air or gas. The absolute reaction velocity was measured with oxygen (10^{-4} moles/cm.^{2} sec.), and the order of reaction was found to be much lower than unity, varying from 0·4 to 0·8, the usual assumption of a first-order reaction not being confirmed. The deviation from unity is regarded as applying to the true order. Theory shows that the lower the order of reaction, the earlier and more sharply it passes into the diffusional region.

An acetylene flame emits a continuous spectrum and band spectra corresponding with CH, OH and C_2. Avramenko[5], with a rarified acetylene-air flame, found a new band spectrum corresponding with the so-called 'ethylene bands' and supposed to be due to CHO. Changes of conditions led to its disappearance, so that CHO may be regarded as an unstable intermediate product in the combustion of acetylene.

Several papers on co-ordination compounds have appeared, for example, on hydroxylamine compounds of palladium[6], $[Pd4NH_2OH](OH)_2$ and salts, and very stable Magnus type compounds $[Pd4NH_2OH]\,[PtCl_4]$; thiosulphate compounds of palladium[7] of two types; and iridium sulphites of the type of Claus's salt[8].

Several interesting papers of metallurgical interest have been published[9].

In the field of organic chemistry, mention may be made of a synthesis of cyclopentylpentene[10], organometallic compounds of mercury[11], and the synthesis of olefins with a quaternary carbon atom[12].

It is not possible in such a short notice even to mention the many other interesting and important papers, but some indication has perhaps been given of the great activity in chemical research in the many institutions of the U.S.S.R.

[1] *Acta Physicochim. U.R.S.S.*, 18, 370 (1943).

[2] *Acta Physicochim. U.R.S.S.*, 18, 358 (1943).

[3] *Acta Physicochim. U.R.S.S.*, 10, 555 (1939).

[4] *Acta Physicochim. U.R.S.S.*, 18, 387 (1943).

[5] *C.R. Acad. Sci. U.R.S.S.*, 40, 110 (1943).

[6] Goremykin, *Bull. Acad. Sci. U.R.S.S.* (Chim.), 248 (1943).

[7] Riabchikov and Issakova, *C.R. Acad. Sci. U.R.S.S.*, 41, 161 (1943); Riabchikov, *ibid.*, 41, 208 (1943).

[8] Lebedinsky and Gurin, *C.R. Acad. Sci. U.R.S.S.*, 40, 322 (1943).

[9] For example, Mikheeva and Krjukova, on the ternary T-phase in the Al, Mg, Zn system, *Bull. Acad. Sci. U.R.S.S.* (Chim.), 296 (1944); Boky and Wainstein, on crystal chemistry of Laves phases, *C.R. Acad. Sci. U.R.S.S.*, 40, 232 (1943); Sirota, on the thermodynamics of intermetallic compounds, *C.R. Acad. Sci.*, 44, 331 (1944).

[10] Galpern, *Bull. Acad. Sci. U.R.S.S.* (Chim.), 397 (1943).

[11] Nesmejanov and Luzenko, *Bull. Acad. Sci. U.R.S.S.* (Chim.), 296 (1943).

[12] Lieberman and Kasansky, *C.R. Acad. Sci. U.R.S.S.*, 40, 353 (1943).

FORTHCOMING EVENTS

Saturday, December 8

British Association for the Advancement of Science, Division for the Social and International Relations of Science (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1).—Conference on "Scientific Research and Industrial Planning" At 10.15 a.m.—"Economic Aspects of Research" (Speakers: Prof. P. Sargant Florence, Mr. F. E Smith, Prof M. L. E. Oliphant, F R.S); at 2.15 p.m.—"The Human Factor" (Speakers. Sir Arthur Fleming, Dr. C. P. Snow, Mr. J. Kendall, Prof. J. D Bernal, F R.S., Mr. J. A. Lauwerys).

North of England Institute of Mining and Mechanical Engineers (at Neville Hall, Newcastle-upon-Tyne 1), at 2.30 p m —Mr. F T. P. Dickins: "Training Within Industry".

Monday, December 10

Royal Geographical Society (at Kensington Gore, South Kensington, London, S.W.7), at 5.30 p m.—Major-General G. Cheetham: "New Medium and Small-Scale Maps of the Ordnance Survey".

Tuesday, December 11

Royal Society of Arts, Dominions and Colonies Section (at John Adam Street, Adelphi, London, W C.2), at 1 45 p.m.—Dr. E P Weeks: "Canada and Post-War Reconstruction".

Royal Institution (at 21 Albemarle Street, London, W 1), at 5.15 p.m —Sir Henry Dale, O M, Pres R.S . "Recent Developments in Chemical Therapeutics", (ii) "Sulphanilamide and its Derivatives"

Institution of Electrical Engineers, Radio Section (at Savoy Place, Victoria Embankment, London, W.C 2), at 5.30 p.m.—Discussion on "The Servicing of Radio and Television Receivers" (to be opened by Dr. R. C. G. Williams).

Royal Society of Medicine (at 1 Wimpole Street, London, W.1), at 5.30 p.m —Discussion on "D D.T." (to be opened by Prof. G. R. Cameron, Dr. A. Thelwall Jones and Dr H D. Clarke)

Illuminating Engineering Society (at the E.L.M.A. Lighting Service Bureau, 2 Savoy Hill, London, W C 2), at 6 p.m.—Dr. J. N. Aldington: "Bright Light Sources".

Society of Chemical Industry (joint meeting of the Nutrition Panel of the Food Group and the Institute of Brewing, at the Horseshoe Hotel, Tottenham Court Road, London, W 1), at 6 p.m.—Dr. F W. Norris: "Carbohydrate, Nitrogenous, Mineral and Alcohol Constituents of Beer"; Mr J W. Tullo · "Vitamins in Beer".

Quekett Microscopical Club (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 6.30 p.m —Scientific Papers.

British Institution of Radio Engineers, Scottish Section (at Heriot-Watt College, Chamber Street, Edinburgh 1), at 7 p m —Prof. M. G. Say: "Ultra-High Frequency Techniques".

Sheffield Metallurgical Association (at 198 West Street, Sheffield 1), at 7 p m.—Dr. C. Sykes, F.R S · "Hydrogen and its Importance in Large Masses of Steel".

Wednesday, December 12

Royal Society of Arts (at John Adam Street, Adelphi, London, W.C.2), at 1 45 p m.—Sir Horace Wilson, G C.B.: Amulree Memorial Lecture.

Institute of Petroleum (at 26 Portland Place, London, W.1), at 4.30 p.m —32nd Annual General Meeting; at 5.30 p.m.—Mr. J. F. Waters · "Some Problems encountered during Well Shooting Operations in the Nottinghamshire Oilfields".

Institution of Electrical Engineers, Transmission Section (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m. —Dr E. Billig: "Mechanical Stresses in Transformer Windings".

British Association of Chemists (joint meeting of the London Section with the Scientific Film Association, in the Cinema of the British Council, 3 Hanover Street, London, W.1), at 6.30 p.m.—Programme will include films on Penicillin, D.D.T., and the discovery of a new pigment.

Thursday, December 13

London Mathematical Society (at the Royal Astronomical Society, Burlington House, Piccadilly, London, W.1), at 3 p.m.—Prof. G. F. J. Temple: "Newtonian Aerodynamics".

Royal College of Surgeons of England (at Lincoln's Inn Fields, London, W.C.2), at 5 p.m.—Prof. W. E. Le Gros Clark, F R.S.: "The Contribution of Anatomy to the War".

Royal Institution (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Sir James Jeans, O.M., F.R.S.: "Physical Astronomy", (iii) "The Dust and Gas of Interstellar Space".

Institution of Electrical Engineers, Installations Section (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m. —Mr. F. W. Tomlinson and Mr. H. M. Wright · "Mineral-Insulated Metal-Sheathed Conductors".

Society of Instrument Technology (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 6 p.m.—Mr. G. H. Farrington: "Automatic Temperature Control of Jacketed Pans".

Institute of Physics, London and Home Counties Branch (in the Reid-Knox Hall, British Institute of Radiology and Röntgen Society, 32 Welbeck Street, London, W.1), at 6.30 p.m.—Dr. E. G. Richardson: "The Production and Applications of Supersonics".

Women's Engineering Society, Manchester Branch (at the Engineers' Club, Albert Square, Manchester), at 6.30 p.m.—Prof. H. Wright Baker: "Recent Trends in the Education of Engineers".

Pharmaceutical Society (at 17 Bloomsbury Square, London, W.C.1), at 7 p.m.—Dr. C. J. Blok: "Pharmaceutical Conditions in Holland under the German Occupation".

Royal Society of Tropical Medicine and Hygiene (at Mans House, 26 Portland Place, London, W.1), at 8 p m.—Discussion "The Teaching of Tropical Medicine" (to be opened by Dr. L Evera Napier).

Friday, December 14

Physical Society, Optical Group (in the Lecture Theatre, Scien Museum, Exhibition Road, London, S.W.7), at 3.30 p.m.—Discussi on "The Coating of Optical Components to reduce Reflection" (to opened by Dr. K. M. Greenland).

Royal Astronomical Society (at Burlington House, Piccadill London, W.1), at 4.30 p.m.—Scientific Papers.

Royal Institution (at 21 Albemarle Street, London, W.1), 5.15 p m.—Prof. M. L. Oliphant, F.R.S.: "The Utilization of Nucle Energy".

Institution of Electrical Engineers, Measurements Secti (at Savoy Place, Victoria Embankment, London, W C.2), at 5.30 p. —Mr G. F. Shotter and Mr. H. D. Hawkes · "A Precision A.C /D. Comparator for Power and Voltage Measurement".

British Association of Chemists, St. Helens Section (at t Y.M.C A. Buildings, St. Helens), at 7.30 p.m —Mr. A. V. Harriso "Technical Education and its relationship with Industry".

Saturday, December 15

Association of Scientific Workers, Leeds Branch (at t Riley-Smith Hall, University Road, Leeds 2), at 2 30 p.m.—Seco Conference on "Science and Education". Prof. J. D. Bernal, F.R.S "The Policy of the Association of Scientific Workers in regard Science and Education".

Society of Chemical Industry (joint meeting of the Food Gro with the Yorkshire Section of the S.C.I. and the Hull Chemic and Engineering Society, in the Lecture Theatre of the Min Department, The University, Leeds), at 3 p m.—Mr. J. Pryce Jone "Honey".

APPOINTMENTS VACANT

Applications are invited for the following appointments on before the dates mentioned.

Engineering Assistant—The Engineer and Manager, Northampton Water Undertaking, Municipal Offices, Fish Street, Northampton (December 14).

Lecturer in Mechanical Engineering, to teach Productio Engineering Subjects, Machines Theory and Design—The Principa Derby Technical College, Normanton Road, Derby (December 14).

Assistant Engineer for large Rubber Works in Scotland—Th Ministry of Labour and National Service, Appointments Departmen Technical and Scientific Register, Room 670, York House, Kingsway London, W.C.2, quoting C.2806.XA (December 15).

Assistant Lecturer (temporary) in Mathematics—The Registra University College, Hull (December 15).

Lecturer (full-time) in Physiology—The Clerk to the Governin Body, Battersea Polytechnic, Battersea, London, S.W 11 (Decembe 15).

Secretary of the Appointments Board—The Registrar, Th University, Manchester (December 15).

Electrical Engineer by the Sudan Railways—The Ministry Labour and National Service, Appointments Department, Technica and Scientific Register, Room 670, York House, Kingsway, London W.C.2, quoting D.1590.A (December 17).

Civil Engineering Assistant—The Engineer-in-Chief, Sout Staffordshire Waterworks Co, 50 Sheepcote Street, Birmingham 1 (December 21)

District Mechanical Engineer (Workshops) by the Iraqi Stat Railways—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 67 York House, Kingsway, London, W.C.2, quoting C.2429.A (Decembe 22).

Lecturer in Physics in the University of Cape Town—Th Ministry of Labour and National Service, Appointments Departmen Technical and Scientific Register, Room 670, York House, Kingsway London, W.C.2, quoting A.1197 A (December 29).

Assistant Lecturer in Botany—The Registrar, The University Sheffield (December 31).

Lecturer (full-time) in the Department of Physics and Mathematics—The Principal, Birmingham Central Technical College, Suffol Street, Birmingham 1 (December 31).

Lecturer in Physical Chemistry, and an Assistant Lecture in Chemistry—The Registrar, The University, Sheffield (Decembe 31).

Lecturer in Production Engineering at the Municipal College Southend on-Sea—The Chief Education Officer, Education Office Warrior Square, Southend-on-Sea.

Junior Assistant Bacteriologist (B Sc.) for Central Laborator —The Medical Officer of Health, 23 Montrose Street, Glasgow.

Research Assistant in the Department of Bacteriology—The Principal, Harper Adams Agricultural College, Newport, Shropshire.

Young Graduate, preferably in Physics or Physical Chemistry for research work on moulding materials, their properties and testing and a Young Graduate, preferably in Chemistry or Metallurgy for research on corrosion and related problems—The Director, Britis Cast Iron Research Association, Alvechurch, Birmingham.

Technical Assistants (Chemical) for Petroleum Research Laboratory in London area for small experimental plants—The Ministr of Labour and National Service, London Appointments Office, 1– Tavistock Square, London, W.C.1, quoting CN.48.

Bacteriologist with a good knowledge of serological method, t assist in the study of streptococci associated with acute disease i infants—The Secretary, National Institute for Research in Dairying Shinfield, Reading, Berks.

University [illegible] of Science
PHYSICS Dept.
Upper Circular Road

NATURE

No. 3972 SATURDAY, DECEMBER 15, 1945 Vol. 156

CONTENTS

	Page
her Technological Education in Britain	699
erpretation of Fantasy as a Clinical Technique. By Dr. John Cohen	701
l Erosion in New Zealand. By G. V. Jacks	703
Elements Rage. By Prof. D. Brunt, F.R.S.	703
blin Colloquium, 1945. By Prof. Max Born, F.R.S.	704
e Royal School of Mines: Geology, Mining and letallurgy at the Imperial College. By Prof. W. R. ones	706
e Allied Plan for Education. By Dr. E. F. Armstrong, .R.S.	708
titution of Metallurgists: Inaugural Meeting	710
ws and Views	711
ters to the Editors :	
A Simplified Chemical Notation.—Sir D'Arcy Thompson, C.B., F.R.S.	715
Life-time of the Neutral Meson.—Dr. A. Pais	715
Mechanism of Brittle Rupture.—J B. Murgatroyd and R. F. Sykes	716
High Permittivity Crystalline Aggregates.—Prof. Willis Jackson and W. Reddish	717
Autoxidation of Linoleic Acid.—Sune Bergström	717
Primary Degradation Products of Mepacrine in Human Urines.—D. Ll. Hammick and S. F. Mason	718
Instability of Dienœstrol and Stilbœstrol Solutions.—A. E. Wilder Smith and P. C. Williams	718
Parathyroidectomy and Lactation in the Rat.—A. T. Cowie and Dr. S. J. Folley	719
Nature of the Gram-positive Complex in Micro-organisms.—Dr. H. Henry, Dr. M. Stacey and Dr. Ethel G. Teece	720
Late Flowering of Horse-Chestnut.—Miss E. M. Blackwell ; Dr. H. G. Baker	721
e Indian Statistical Institute	722
cavations at Hyrax Hill, Nakuru, Kenya Colony. By M. C. Burkitt	722
utomatic Control and Recording in Chemical and Other Processes	723
ant Pathologists in Great Britain	724
ospital Diet. By Dr. G. Lapage	725

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HIGHER TECHNOLOGICAL EDUCATION IN BRITAIN

THE need for a considerable expansion of the research effort of Great Britain is now generally accepted, and on every hand industrial concerns, industrial research associations, and government departments are taking steps to increase their research facilities. These efforts are being made on the assumption—and it must remain an assumption for some time to come—that there will become available more men and women capable of conducting research successfully. Granted this, however, those of our national problems which demand for their solution more scientific and technical research will in fact be solved only if there become available also more men and women capable of translating the results of research speedily and efficiently through the various stages of development into large-scale production.

It has not perhaps been sufficiently recognized that notwithstanding the paucity, in quantity, of the pre-war research effort of Great Britain relative to that of certain other countries, we did not compare unfavourably with any in the production of new ideas and the practical demonstration of new principles. Our deficiency lay in the ability to engineer our scientific and technical achievements on an adequate scale. Those who say that before doing more research we ought to use more effectively what has been done already are not speaking nonsense; they are giving warning of a danger which we shall be wise not to ignore in the years ahead.

The scope and difficulty of the whole problem of educating and training the technical personnel required by industry in these connexions has increased considerably with the rapid expansion and growing complexities of scientific knowledge and technical development. This problem has received much attention in Britain during recent years from the professional bodies concerned, and a report on the matter by a Committee appointed by the Government in April 1944 under the chairmanship of Lord Eustace Percy has been keenly awaited*. The terms of reference of this Committee were as follows : "Having regard to the requirements of industry, to consider the needs of higher technological education in England and Wales and the respective contributions to be made thereto by Universities and Technical Colleges, and to make recommendations, among other things, as to the means for maintaining appropriate collaboration between Universities and Technical Colleges in this field".

In its report, this Committee states that its original intention had been to make successive reports on the educational provision required to meet the needs of various industries, but that in view of the magnitude of the problem it has limited itself to a consideration of the field of engineering, and has used this to illustrate the form of organizing body which it recommends should be established. It has further limited its consideration to the 'professional' category of engineer. These restrictions are somewhat unfortunate, for much might have been gained from a comparison of the needs and experiences of the engineering and chemical industries, and also since the Institutions of Electrical and Mechanical Engineers have been laying stress on the rapidly growing importance of a grade of personnel lying between the professional and craft grades. This grade comprises men engaged as technical assistants in research and development, designer-draughtsmen, testers, inspectors, etc., for whom the technical colleges have thus far made little specific provision. The industrial demand for better trained men of these types is urgent, and the technical colleges have no more important function to discharge.

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* Ministry of Education Higher Technological Education. Report of a Special Committee appointed in April 1944. Pp. 32. (London : H.M. Stationery Office, 1945.) 6*d*. net.

Hitherto, the main avenues to professional recognition in engineering in Britain have been degree courses at the universities and part-time national certificate courses at the technical colleges. The total pre-war output of these courses was about two thousand a year, of whom about one-third were university graduates in engineering and a small proportion holders of higher national diplomas gained by two years full-time attendance at a technical college. So late as 1937–38, four-fifths of the Higher National Certificate students received their instruction in evening classes, a system which is now generally recognized as wholly inappropriate to the standard demanded of the professional engineer.

During the War, the annual output of professionally qualified engineers has been raised to about 2,700, and the Committee estimates that this figure must be maintained. The present capacity of the university departments of engineering in Britain is stated to be about 1,200 a year, leaving some 1,500 to be accommodated by the technical colleges. The report divides the latter into three groups: 1,000, who will attain the Higher National Certificate via part-time courses, but on a day-time and not an evening basis; 150, who it is assumed will elect to work, as in the past, for a London external degree (although the system of external degrees is regarded by the Committee as an anomaly); and the remaining 350 for whom it is suggested specially planned courses should be provided.

Regarding these latter courses, the Committee states: "we would insist that such courses should be directed to the development of the highest level of the teaching of the art of technology, based on a sufficient scientific foundation. Such courses should have a status in no way inferior to the University type of course; they should require equal ability in the student; and they should afford a preparation for the most advanced post-graduate courses. But they will be different from University courses; and their development should not, therefore, be hindered or deflected by University affiliations or by arrangements for the grant of University degrees whether by existing universities—or, as some of our witnesses have suggested to us—by some new national technological university created purely for purposes of examination and standardization."

The provision of these special higher technological courses would be a function of a strictly limi number of technical colleges, to be called 'College Technology'. In addition, these colleges would expected to cater for a large volume of part-ti work leading to Higher National Certificates and I qualifications, and to develop postgraduate cour in special branches of technology "intended genera for their own graduates or for graduates from Univ sities, and for men who have been in industry some time". The colleges of technology would subject to the ultimate control of the providing lo authority in matters of finance and general polic but in order to ensure maximum co-ordination effort with adjacent universities and technical colle it is recommended that regional advisory counc and regional academic boards of technology be up, themselves co-ordinated in a 'National Coun of Technology'.

The need for a number of the larger technic colleges, acting in close collaboration with the univ sities, the professional institutions and local indust to provide both full- and part-time postgradua courses in the branches of technology relevant to th respective regions cannot be over-emphasized. Certa regional advisory councils for higher education a already engaged on this matter, and their effo would be strengthened considerably by the formati of a national co-ordinating body such as is suggeste With this aim of the recommendations there will general agreement; but there will be differences opinion on the case which the Committee has attem ted to make for the establishment of a new type undergraduate course, whatever be the title, B.Tec Diploma in Technology, associate of the Roy Colleges of Technology, by which, different groups the Committee suggest, success in the course mig be rewarded.

It is stated that failure to meet the demands of (t engineering) industry in the past have been d partly to deficiencies in the courses of education a training. Yet the Committee's analysis of these de ciencies does not extend beyond such tentative stat ments as "University undergraduate courses ma have been too short and too specialized", and " courses for the Ordinary and Higher Nation Certificates there may have been too little of th early scientific grounding which is as necessary to t art, as it is to the science, of engineering or of an other branch of technology". The Institution Electrical Engineers has not been so hesitant i its comments on the present inadequacy of t scientific foundation afforded by both these types course, and has asked that the deficiency be correct in both cases without delay. It can be corrected National Certificate courses, of course, only on th basis of a general replacement of evening by day-ti classes, and this arrangement the Percy Committ has in mind for the thousand engineers who are t attain professional status through this channel.

The Committee has not made clear enough how th new courses, intended to cater for 350 persons a yea are to differ from the improved versions of the ol which are to serve for the remaining 2,350 of the sam age-group. They are to emphasize the art of engi ring, "in which aspect it is concerned with the ecial application of general principles to particular oblems of production and utilization", but *not glect* the science, "in which aspect it is concerned ith general principles which are valid for every plication"; and they are to require equal ability to at required for success in a university degree course. iese are vague statements, and there are many hers. The suggestion of an undergraduate course ealing with the production side of engineering is not ow, but thus far no serious attempt has been made define a possible content or to assess the intellectual scipline which such a course would afford. These atters should have been dealt with more fully, and ust be clarified before a reliable assessment of the roposal can be made. The trend of informed opinion ould seem, however, to have been in the reverse rection.

The crux of the whole matter is that the production f the high-grade technologist requires a longer period ian we have been prepared to devote to it, and to vade this issue will be fatal. The complex problems ith which he is now faced demand that his training hall not merely *not neglect* science—by which should e understood the basic subjects of chemistry, physics nd mathematics—but shall aim increasingly at roadening his appreciation of it, and inspire the ealization that the impact of science on technology s a continuous and expanding process. Any action herefore which does not facilitate a tightening of the resent inadequate link between the two is retrogres-ive. For this reason the suggestion that colleges of echnology be set up separately from the universities nd their faculties of science requires the most careful onsideration. 'Colleges of Science and Technology' s an integral part of the university system appear more desirable goal, and would permit a more ready olution of the highly important problems of adjust-nent and of student transfer between universities and echnical colleges to which the report refers.

The scheme envisaged is superficially attractive; he advantages of full-time over part-time courses at the educational stage under consideration are unquestionable, while the administrative problems involved in implementing the recommendations would be minimal. This is no doubt an important consideration in times of emergency; but urgent as the problem may be, we shall be wise to consider before action is taken whether the courses and arrangements proposed are likely to produce the high-grade technologists required.

Other recommendations contained in the report are extremely welcome, and it is to be hoped that they will be acted upon without delay. Thus, in stressing the importance of a much increased flow of able boys from part-time to full-time courses of study, and referring to the manner in which this has been facilitated academically by the institution in some universities of an industrial matriculation, the Committee recommends an extension of the national system of scholarship awards to make this transfer more possible financially. It also recommends the institution of a campaign to increase the prestige and attractiveness of the technical professions; the establishment of a centre for the postgraduate study of industrial administration; and more positive arrangements to enable teachers of technology to keep abreast of industrial development. There is, of course, equal need for them to keep abreast of scientific development; and this, in itself, is a powerful reason for securing the closest possible merging of their departments with university departments of science.

INTERPRETATION OF FANTASY AS A CLINICAL TECHNIQUE

Controlled Projection (1944)

A Standard Experimental Procedure. Arranged by John C. Raven. Pp. 54. (London: H. K. Lewis and Co., Ltd., 1945.) 12*s*. 6*d*. net.

RECENT developments in projective technique offer a new approach to the mind, the exploration of which is just beginning. The underlying concept of projection (attributing our own 'qualities' to others) owes its origin to Freud. It was postulated to explain the origin of delusions of persecution and ideas of reference in paranoia. Freud thus identified a distinctive mental process of which we had only been vaguely aware. Many proverbs embody the belief that projection enters into daily intercourse. Folk-knowledge recognizes that in judging others we judge ourselves, that in condemning or condoning the actions of others we betray our own private inclinations. In the narrower sense in which Freud understood it, however, projection is a mechanism of defence employed, as an alternative to repression, with the aim of ridding the mind of an intolerable burden of aggression or guilt. Some recent experiments have thrown further light on these alternative *extra-* or *intro*-punitive processes.

Projection helps to shape our relationships with the outer world. We 'infer' from the dim or clear awareness of our own state of mind the state of mind of another person. It is not inference in the logical sense of inductive reasoning, but arguing by analogy from one particular to another. In Spearman's terminology, projection means educing correlates of our own social attitudes. Taken jointly, projection and correlate eduction are rich in explanatory value. Thus, to take one example, the late Prof. Aveling showed that ideas of cause and effect are generated (educed as correlates) by projecting on to external objects the experience of the self acting upon the organs and limbs of the body.

The recognition that projection plays a major part in the organization of mind has led to its being exploited as a method of penetrating beneath the surface of personality. Indeed, the importance of projective techniques to the psychologist has been likened to that of the X-ray apparatus to the physician. A person's projections can be evoked so as to uncover his innermost impulses, wishes, fears and values. He will interpret an ambiguous social situation in a way which, unknown to himself, will disclose some of the hidden secrets of his mind. In choosing his invective he will most likely dip into his personal inventory of self-condemnation. In forecasting an event on inadequate data he will project himself into his predictions, thus revealing what he *wants* to happen or what he privately fears *might* happen. He may perhaps project his own ignorance into the outside world. This last possibility was well exemplified by the Press in 1941 when ignorance of Japan's plans in regard to entering the War was projected on to the Japanese rulers, who were believed to be utterly uncertain of their own intentions.

Projective techniques are methods of indirectly locating crucial foci of value and conflict. Just as a searchlight, in projecting its beams on to an object, discloses its own location, so the mind by projecting its own wishes, hostility, fears and values, reveals its key centres of activity. Projection is something more than a subjective mental process. It has a social quality inasmuch as it is the main avenue for the mind's interpretation of its environment, human and material. Hence its significance for the study of interpersonal relations.

In England, projective techniques appear to have been first used by Wedeck in 1933 and described by him in a thesis deposited in the University of London library. His object was to inquire whether any 'group factor' existed which implied a special ability for understanding human character and relationships, whether, in other words, the interpretation of facial expression, gestures, social situations, proverbs and the like, required an ability statistically independent of general intelligence (Spearman's '*g*' factor). Wedeck did, in fact, claim to have detected a special ability of estimating character uncorrelated with '*g*'.

The potentialities of projective techniques in the study of personality were first fully appreciated, however, in the United States. H. A. Murray seems to have been early in the field. He set out the methods in his "Explorations in Personality", which attracted curiously little attention in England when it was published in 1937. He had a different purpose in mind; not to find out whether the subjects were good judges of character or not (as measured by some agreed criterion), but to discover their general mental and social orientation.

There is variety in projective techniques. The basic procedure requires that the subject should freely manipulate experimental materials presented to him. Alternatively he may be required to interpret the materials or situation, or he may be asked to carry out certain prescribed acts under observation. The underlying assumption is that the subject will employ the material or situation so as to express his inner values, his mental conflicts, his tendencies, aspirations and imaginary roles. He throws or projects himself into the medium of expression. Such techniques include the Rorschach Test, the Thematic Apperception Tests of Murray (briefly known as TAT), psychodramatic situations, and, in the case of children, play activities. Closely allied procedures are observations of expressive movement, posture, gait and physical activity of almost any kind. The fantasies projected by the subject or patient are not regarded as final indications of the trends in his mind but simply used as working hypotheses to be checked by other criteria. Murray's tests, which are the most important of these devices, were developed at the Harvard Psychological Clinic. In principle similar to the Rorschach Test, the material consists of reproductions of paintings instead of 'ink-blots'. The latest revision of the thematic apperception tests has just been published. Though originally devised for adults of normal intelligence, the tests have also been applied to mental defectives.

The exigencies of war soon determined that, in the interests of military efficiency, methods should be adopted for the assessment of personality in selecting personnel for higher duties. As is now perhaps well known, the important step was taken 1942 of introducing projective techniques into W Office Selection Board procedure as an aid in sele ing candidates on grounds of 'officer quality' or lead ship. Here the current tests of intellectual abilit were not appropriate and the new methods were great help in detecting weakness and strength in t personality structure of candidates, and in t adequacy of their social adjustment. Similar metho are now being employed in selecting candidates f the higher grades of the Civil Service.

Raven's work, stimulated by Murray's efforts a by the 'completion test' of a French investigat M. Thomas, introduces new steps in testing procedur part of which is common both to children and adults. The subject is asked to draw, and wh he is drawing, to imagine and describe a series events. Since he is occupied with two tasks there little residual energy left for self-observation or sel criticism. There are supplementary tests suitab for adults only. Although best results are obtain with individual administration, an adaptation of t test material is also provided for administration t adult groups.

Raven uses two kinds of material, verbal an spatial simultaneously, and he 'pursues' the subject fantasies in a number of prescribed directions. The is thus a twofold pursuit of the subject's projection In the result two distinct yet parallel forms of expression emerge side by side, one oral the othe pictorial; each is a check on the other. Both th verbal utterances and the drawings can be systematically followed, step by step, by the experimente until he is satisfied that his explorations of the subject's personality are as complete as necessary. Th materials used are simple and lack any structur of their own.

The ambitious aims of 'projection pursuit' ar clearly set out by Raven. It is not facts about th subject's past which are sought, but his interpretatio of the events of life, how he organizes his thought and actions, how he regards other people and how h imagines other people regard him, what motives h attributes to the actions of others, what are his like and dislikes, his wishes and judgments, and how, o the basis of these, his character is formed. Th sample records given by Raven illustrate (they ar not norms) what results are to be expected of childre at different age- and ability-levels within the norma range of intelligence. Some records are also given of th projections of adults differing in age, sex and ability.

Several criticisms of the present stage of Raven' techniques come to mind. The methods do not, as is claimed, appear to be appreciably subject t controlled variation. Nor do the results lend themselves at all easily to statistical treatment. Above all, to interpret the records is exceedingly difficult, and practically no guidance is offered on the subject. Raven admits that much has still to be learnt about the most informative questions to be put, about the best methods of pursuit, and about ways of recording the responses. These limitations the reader will readily concede.

The value of the present arrangement of test material lies less in what it achieves than in what it foreshadows. It provides not so much a procedure ready for clinical application as a "method of enquiry suitable for experimental work"; it is therefore as a pioneer effort that the work is to be judged, and the reader must not be too critical, though there is much to criticize.

JOHN COHEN.

OIL EROSION IN NEW ZEALAND

il Erosion in New Zealand
Geographic Reconnaissance. By Kenneth B. umberland. Pp. xi+227+43 plates. (Wellington: il Conservation and Rivers Control Council, 1944.)

A FIVE-YEARS survey convinced the author "that New Zealand, the youngest of the British ominions, has a soil-erosion problem of greater nificance in its relation to the future well-being the country than has any one of the older members the Commonwealth". He estimates that more an two thirds of the occupied area suffers from an-induced erosion.

The author approaches his subject from the geo-aphical rather than from the agricultural point of ew. Erosion in New Zealand has a regional char-ter, assuming distinct forms according to the imate, geology and related land use. Four erosion gions are distinguished in the North Island and ur in the South Island. The most striking, and in e North Island one of the most prevalent, forms erosion is the landslip which has devastated mense areas following the clearing of the bush. andslip erosion is the consequence not, only of uman intervention, but also of the geological struc-ure of the country. It seems to occur as a result a slight disturbance in a delicately balanced quilibrium of physical and biological forces—most equently on steep, deforested land that has gone own to grass. A secondary result of erosion that as caused widespread damage in New Zealand has een the silting-up of rivers and consequent floods. somewhat unusual form of erosion that is prevalent certain areas is called by the author "subcutaneous rosion", and results in the washing away of the npermeable subsoil while the permeable, grassed opsoil remains intact. Ultimately gullies and sink-oles are formed. The rapidity with which erosion as occurred in New Zealand is due in no small easure to the extensive and repeated use of fire s a means of clearing the virgin bush.

Since New Zealand possesses few other major atural resources besides the fertility of the soil the roblem of control is urgent. The author is more oncerned with erosion than soil conservation, though he latter is discussed on general lines, and regional chemes based on adapting land use to the limitations mposed by the natural environment are suggested. lthough the separate measures recommended—fforestation, improvement and control of pasture and, contour cultivation and strip-cropping—are hose which are commonly advocated elsewhere, they equire a different and unique synthesis into an ntegrated land-use programme, for the New Zealand limate is, on the whole, more maritime and less ubject to extremes of temperature and humidity han the climates of most countries where erosion ontrol has been scientifically studied. The author tresses the need for intensive research and State ction on a large scale. In 1941 the Soil Conservation nd Rivers Control Act became law, and a Soil onservation and Rivers Control Council was set up ith wide powers to carry out both conservation neasures and research.

Sufficiently detailed accounts are given in a series f appendixes of the geological, climatic, vegetational nd soil characteristics of the country to enable the eader who is unacquainted with New Zealand to et a clear picture of the geographical background of the problem. The book is illustrated with numerous beautiful and dramatic photographs. It should be read by everyone who is interested in this grave and widespread disease of the land. G. V. Jacks.

THE ELEMENTS RAGE

The Elements Rage
By Frank W. Lane. Pp. xii+188+47 plates. (London: *Country Life*, Ltd., 1945.) 10*s*. 6*d*. net.

THE more violent manifestations of Nature are of relatively infrequent occurrence, and so come into one individual's experience only at long intervals. If, then, we had to rely on the experience of one man only we should have a very inadequate picture of these abnormal phenomena. The author of the book under review has read and summarized a very great mass of literature dealing with hurricanes, tornadoes, waterspouts, hail, snow, lightning, meteorites, earthquakes and volcanoes, and from this has produced a readable book, in which a chapter is devoted to each of the nine topics enumerated above. To describe the book as readable is not to say that the reader will wish to devour it in one sitting. The rather overwhelming phenomena described can only be regarded as suitable for absorption in fairly small doses.

With the view of keeping the book free from error, so far as possible, the author had each chapter read over by at least one expert in the subject dealt with. The result has been to produce what is, on the whole, a reasonably accurate description of the phenomena, with an acceptable theoretical discussion in such parts of the book as call for theory. Here and there we find slips, which appear to indicate errors on the part of the experts, or failure of the author to listen to his experts. Thus on p. 2 we find the statement that "meteorologists define wind speed as the velocity with which the wind would carry a very light object, such as a fragment of thistledown, in a perfectly open situation, thirty-three feet above the ground". This is inaccurate, since wind speed can be defined at any height above the ground, and the wind at 33 ft. (10 metres) is a convenient specification of the surface wind.

But apart from a few unimportant slips, the treatment of the subject is clear and simple, and the book is well illustrated with photographs of tornadoes, waterspouts, hailstones, meteorite craters, earthquakes, volcanic eruptions, and of some of the dreadful damage produced by these phenomena. Among the most interesting parts of the book must be reckoned the four pages that describe the new volcano Paricutin in Mexico, which appeared in February 1943, the first new volcano to appear on the American continent in nearly two centuries. Paricutin appears to outdo Vesuvius in violence, being distinguished by its habit of spouting a hail of large fragments of lava thousands of feet into the air, and so endangering all forms of life in its immediate neighbourhood. A photograph of Paricutin in eruption appears as the frontispiece to the book, showing the magnificent plumes of smoke which tower high above the summit.

Mr. Lane has performed a very useful service to all who are interested in the violent manifestations of Nature, by writing a coherent account of these, and collecting into one volume the known facts relating to them. The book deserves to be widely read. D. Brunt.

DUBLIN COLLOQUIUM, 1945

By Prof. MAX BORN, F.R.S.
Department of Mathematical Physics, University of Edinburgh

THIS year's Colloquium or Summer School of the Dublin Institute for Advanced Studies was held during July 5–18. I have described the character of the Institute and of these annual meetings in a review of Schroedinger's lectures on "Statistical Thermodynamics"[1]. The lecturers of this course were Dirac (Cambridge), Jánossy (Manchester) and myself, to whom was added less officially W. H. Peng, my former Chinese collaborator, who has now been appointed assistant professor at the Dublin Institute.

The audience was more international than during the war-time colloquia; apart from Peng, there were students from Brazil, Ceylon and Palestine, an Austrian sent by a London body (British Electrical and Allied Industries Research Association) and others. Yet the majority was Irish, some of them priests of the Roman Church. Coming straight from the Academy celebrations in Moscow, I was struck by the profound contrast between these two scientific meetings: there the materialistic idea that science has to serve social progress by producing practical results, here a spiritual attitude of pure research without regard to applications. The character of the conferences corresponded to these fundamental attitudes: in the U.S.S.R., stimulating addresses on wide topics by scholars of all nations, to vast audiences, and visits to enormous laboratories; in Eire, a small number of experts assembled for intensive study and discussion of a few abstract problems.

Yet, great as the difference of atmosphere may have been, one thing there was in common: the acknowledgment of the importance of fundamental research and of the perfect freedom of thought in its pursuit.

In fact, the experience in the U.S.S.R. and in Eire have strengthened my conviction that these two aspects, which are the driving forces behind scientific activity in Governments as well as individuals, are not contradictory but complementary, in a similar sense as the wave and corpuscle aspect are in quantum physics. Practically, both attitudes lead to a result pleasant to the man of science, namely, a highly honoured position in the community. The reception which we members of the Dublin Colloquium were given by the Government, the National University and Trinity College was no less friendly and in its smaller frame no less splendid than that I had experienced in the U.S.S.R.

The lectures and discussions covered three subjects: cosmic rays, quantized field theories and quantum mechanics of crystals.

Jánossy's six lectures dealt with our present knowledge of cosmic radiation, which consists at least of three different components: (1) a soft component (electrons and photons); (2) a hard component (mesons); (3) a component which is primary with respect to the (short-living) mesons, consisting probably of neutrons and protons. Jánossy's report was mainly concerned with the third component, which is much less thoroughly studied than the other two; only one of his lectures was devoted to a feature of the soft component—the cascade theory of showers of photons and electrons. His account of this very complicated mathematical theory was an astonishing fe considering it came from a man we used to look up as an experimentalist. Concerning the third compone Jánossy reported first on observations made Rossi and Regener[2] of a non-ionizing component high altitudes, and then on his own work, in coll boration with Rochester[3], near sea-level. This no ionizing radiation is extremely weak and can observed only with the help of particular tric The apparatus, consisting in a vertical coinciden arrangement of counters, has to be shielded again undesirable ionizing particles. Since absorbers wou obviously not do, the shielding was performed wi the help of a box full of counters (76 in numbe in 'anti-coincidence' arrangement. Only tho discharges of the inner counters are registered 'anti-coincidences' which are not accompanied by discharge of any of the screening counters in th box. An ionizing particle coming from outside th box must necessarily discharge at least one of th screening counters before reaching the inner arrang ment; it produces, therefore, no 'anti-coincidence But a non-ionizing particle entering the box fro outside does not affect the screening counters; b a proper arrangement of scatterers inside the bo it has the opportunity of producing an ionizin secondary which is then registered. In this way th existence of non-ionizing rays more penetrating tha photons could be established.

Showers of penetrating particles have been observe by Wathaghin and his co-workers[4] and indepen dently by Jánossy[5] with the help of various counte arrangements. The rate of these penetrating shower was found to increase when absorbers of lead wer placed above the counters; this indicates the pro duction of secondary penetrating showers in the lead The particles responsible for these showers wer shown to be partly ionizing and partly not; the mean range was found to be about 5 cm. of lead All these experimental results can be interpreted i terms of the theory, developed by Hamilton, Heitle and Peng[6], of the production of mesons by nucleon

Another set of observations is concerned with th spreading-out over large areas of penetrating shower consisting of many particles[7]. The total energy o such showers is extremely high, and no interpretatio of this phenomenon has been given so far.

Dirac's main subject was quantum electrodynamic (four lectures). But one additional lecture wa devoted to quaternions, as a particular homage t their discoverer, Dublin's greatest mathematician Sir William Hamilton. In this lecture, Dirac deal with the application of quaternions to Lorentz transformations.

Previous work on this subject has always connecte the Lorentz transformation with bi-quaternions, bu here the need for introducing bi-quaternions wa avoided by subjecting ordinary quaternions to group of linear transformations with a denominator which group is then reduced to just the Lorentz group. The method leads to an elegant formulation of the law of addition of velocities in relativity theory in terms of quaternions.

Dirac's method of treating quantum electrodynamics is to keep closely to classical electrodynamics The Lorentz equations of motion of charged particle (including radiation damping) together with Maxwell' field equations may be considered as an exact classica scheme, which can be put into Hamiltonian form by using the 'Wentzel field'. From this Hamiltonian form of classical electrodynamics one can pass ove the quantum theory by the same rules as for rticle mechanics. The difficulty that then arises to solve the resulting wave equations, as the linary perturbation method leads to divergent egrals.

One can make some progress by the device of troducing redundant field variables. This makes e solution of the wave equations much easier and oids the divergent integrals, but throws the fficulty on to the question of interpretation. If e keeps to the standard method of interpreting ve functions in quantum theory, one must eliminate e redundant variables, and this would again troduce the divergent integrals if one expresses the ave-function as a power series in the electronic arge. However, from the general form of the wave nction in the redundant variables it seems likely at one can carry out the elimination by better athematical methods not involving power series, ithout getting divergent integrals. If this is so, it ould mean that the appearance of divergent in-grals in the solution of the wave equations is to be tributed to wrong mathematical methods and not any fault in the physical theory.

A further lecture dealt with the way the wave nctions of quantum electrodynamics transform under orentz transformations. These wave functions are not xpressible in terms of tensors and spinors in space-ime, but involve a new kind of quantity with an finite number of components, which has already een dealt with[8].

Finally, a lecture dealt with what one can say bout the *position* of a photon. A particle in non-elativistic quantum theory can have its position pproximately defined, and its state is then described y a wave packet. This is no longer possible in elativistic theory; but it turns out that there is omething playing the part of a wave packet, de-cribable mathematically in terms of a complex ariable of position

My own lectures consisted of two quite different ets. In the first set (two lectures) I dealt also with uantum electrodynamics, or more generally with uantized field theories. The infinities appearing in hese theories may be either a consequence of wrong hysical assumptions or of bad mathematics. In he first case one must try to find a weak point in he present theory, this seems to me the use of the rdinary Fourier transformation connecting space o-ordinates with momentum components. Peng and I have shown that one can replace the Fourier method by a new set of commutation laws for the field components; the elementary oscillators repre-sented in the older theory by quantized Fourier coefficients appear now as irreducible parts of the set of matrices representing the field components. To these parts we have given the name of 'apeirons'. The distribution of the apeirons can be chosen in such a way that the infinite integrals of the older theory become convergent. I further stressed the point that a satisfactory theory of interaction between different kinds of particles can only be achieved by treating all of them on the same footing, as quanta attached to the corresponding fields.

From this point of view Peng has made a careful investigation of the mathematical methods used in deducing the properties of particles, or quantized fields, in interaction; he gave a short account of this work in two lectures.

The ordinary method consists in an expansion with respect to powers of the coupling parameter (electric charge in the case of photon-electron inter-action); this method fails because the unperturbed system is highly degenerate. Just as in ordinary quantum mechanics one has to apply the method of secular perturbations, Peng has shown how this can be done for a quasi-continuous spectrum. His results confirm in first approximation the theory of radiation-damping given by Heitler[9] and Wilson[10]. It seems certain that Peng's method allows us to calculate higher approximations for radiation and collision cross-sections without divergent integrals About the question of self-energy, however, there was a controversy; Peng believed he had obtained a finite value of the so-called 'transversal self-energy', but Dirac raised objections to the proof. (Peng has since informed me that he has confirmed his state-ment.) The ordinary 'longitudinal' self-energy is not covered by Peng's present results; this infinity appears also in the classical theory and I doubt if it can be avoided in quantum mechanics except by Dirac's λ-limiting process.

My last three lectures were devoted to a much simpler subject, some problems of the theory of crystals. Raman and his collaborators have attacked ordinary lattice dynamics on account of optical experiments and tried to replace it by another theory. The main difference is this: they contend that a crystal lattice has only a finite number of vibrations, I think 48n, where n is the number of particles in the cell, while the straightforward appli-cation of dynamics (classical or quantum theory) leads, of course, to the result that the number of vibrations is $3Nn$, where N is an extremely large number, namely, that of the cells. It would not be worth while to refute Raman's theory if all known facts could be explained by lattice dynamics; but that seems to be not the case. The reason is that the theory was developed before the discovery of quantum mechanics; the semi-classical model of a lattice used in my book[11] is insufficient. It is not the dynam-ical part, the theory of vibrations, that is deficient, but the optical part. The deformability of the ions had not properly been taken into account, but this can be easily done by describing their structure with the help of wave functions. I have revised the whole theory of crystals from this point of view and obtained a great number of new results. An example is the theory of pyro-electricity. There was an old discre-pancy between experiment (Ackermann[12]) and theory (Boguslawski[13], Born[14]) with respect to the temper-ature dependence near the absolute zero; it was experimentally found to be proportional to T^2 while the theory gave T^4. This is now cleared up; the improved theory leads also to T^2. A second example is the fine structure of the residual rays (Reststrahlen) found by Barnes[15] and others. Blackman and I[16] have tried to explain it by taking into account the anharmonicity of the lattice vibrations. But I now consider this idea to be wrong; the phenomenon is a direct consequence of the deformability of the ions. Closely connected with this is the Raman effect of the second order. The first successful experiments were made by Fermi and Rasetti[17] on rocksalt; they interpreted their results in the correct way as a continuous spectrum with a number of small narrow maxima. Krishnan[18], however, claims these maxima to be a line spectrum as predicted by Raman's theory. Dr. Mary Bradburn and I[19] have developed the theory in detail and shown that the continuous background and the maxima as well can be derived in fair agreement with the experiments. I do not doubt that the improved lattice theory will be able to explain all cases of Raman effect and other phenomena observed by the Indian physicists.

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THE ROYAL SCHOOL OF MINES

GEOLOGY, MINING AND METALLURGY AT THE IMPERIAL COLLEGE

By Prof. W. R. JONES

TOWARDS the middle of the last century, at the dawn of the industrial age, when the demand for machinery to quicken the pace of life was becoming more and more insistent, the value of the application of scientific knowledge to the many problems confronting Great Britain and the British Empire was becoming realized slowly but surely. In no sphere of activity was the need for such knowledge more marked than in increasing the supply of metals. The pressing demand for these necessitated the search by geologists for the minerals containing the metals; the working of the mineral deposits required mining engineers; and the extraction of the useful metals needed metallurgists. If rapid progress were to be made, it became manifest that the training of geologists, mining engineers and metallurgists was a matter of profound importance. It was the insistent demand for such training—not then available anywhere in the British Empire—that gave birth to what later became known as the Royal School of Mines.

At this period the Geological Survey had as its head Sir Henry de la Beche, a man of outstanding personality and vision who not only dominated the Survey but also wielded great influence with the Government. He had accumulated a large collection of minerals, geological maps, plans of mines and drawings of mining machinery which he housed at Craig's Court, adjoining Scotland Yard, London. This was opened to the public in 1841 as a Museum of Economic Geology to "exhibit the practical application of geology to the useful purposes of life". The exhibit aroused such great interest that the need for more accommodation caused the Government to erect a new building, and on May 12, 1851, the Museum of Practical Geology in Jermyn Street was opened by the Prince Consort.

This gave de la Beche the opportunity he had long cherished of using the Museum and its collection for training in mining and applied science; and months later, on November 6, he delivered t inaugural address as director of the Governme School of Mines and Science applied to the Arts. preparation for this new School, he had gather around him a group of the most eminent men in the particular subjects: Warington W. Smyth f mining and mineralogy; Andrew C. Ramsay f geology and its practical application; John Perc the 'father of English metallurgy'; Robert Hunt f mechanical science with its application to mining. Edward Forbes for natural history applied to geolog and the arts; and Lyon Playfair—afterwards Lo Playfair—for chemistry applied to the arts an agriculture. It is an outstanding tribute to the geni of de la Beche in the selection of his staff that eve member of this brilliant group became a fellow of th Royal Society and achieved international fame; an together they established for the School an unsu passed reputation throughout the Empire.

After the death of Sir Henry de la Beche in 185 Sir Roderick Impey Murchison, a virile leader, succeeded after many rebuffs in changing the title of th School in 1857 to the Government School of Mines and in 1863 to the Royal School of Mines, the titl which it still retains as one of the components of th Imperial College of Science and Technology. Th School was transferred in 1872 from Jermyn Stree to the Royal College of Science (now the Huxley Building) in South Kensington, and, in 1913, to it nearby present home in Prince Consort Road.

The Royal School of Mines is essentially a teachin institution, fulfilling the purpose for which th Imperial College of Science and Technology was incorporated: "to give the highest specialised instruction, and to provide the fullest equipment for the most advanced training and research in variou branches of science, especially in its application to industry". Its particular function is training in the application of the principles of science and engineering to the fundamental industries of mining, metallurgy, and oil.

Geology

From the initial stages of the School, the Geology Department has been closely linked with the Mining and Metallurgy Departments, and with the passage of time this link has become more strongly forged, for now the three departments are housed together in the Royal School of Mines. Two thirds of the students of the Department receive the associateship of the School; the remaining third, studying pure geology, belong to the Royal College of Science. During the last twenty years almost all the students attending the School in any of its departments sit also for the Honours B.Sc. of the University of London.

Sir Henry de la Beche, the founder of the School, Sir Roderick Murchison, his successor as its director and head of the Geological Survey, and Sir Andrew Ramsay, its first professor of geology (1856–76), were all eminent geologists, who played a great part in laying the sure foundations of their science and in building upon them its broad developments. Their achievements have become incorporated in the body of the science.

Advances in geology are rarely spectacular; it is more a case of "precept upon precept, line upon line, here a little, and there a little". The Geology Department can look back with satisfaction on a century of productive research in all branches of the subject.

dd (1878–1905), who succeeded Ramsay, made nd contributions to the Jurassic and Cretaceous atigraphy of Great Britain, and the results of his vestigations into the complexities of the Tertiary lcanicity of the Hebrides are of signal merit. It s been truly stated of him that he established the rst thorough course of practical instruction in ology established in Britain, and perhaps in the rld". He trained a group of practical geologists o have made their mark on geological science in parts of the world—a group containing Boulton, enville Cole, Hume, Sir Thomas Holland, Skeats, llis, Tyrrell, Morley Davies, Rutley, Sherlock and any others is no mean memorial.

Judd was followed by W. W. Watts, who occupied e chair during 1905–30. His contributions to the atigraphy and petrology of Shropshire and the idlands remain of fundamental importance to the ology of Britain. Invaluable also have been his rvices to the science as its counsellor. Building on the foundations of his predecessors, he expanded e departmental courses to keep abreast of progress, d in his teaching he inspired his students and lleagues to undertake research work in various anches of geology. Under his guidance, two new b-departments were instituted to supply men ained for special work in the oil and mining indus- ies. That in oil technology, comprising geology, rveying and engineering was established in 1912; nd under the direction of Prof. V. C. Illing it has ospered exceedingly and has supplied fully trained en to oil companies in various parts of the world. he second special training is in mining geology, hich includes in addition to geology, surveying, ssaying and the principles and economics of mining. his training was fostered by Prof. C. G. Cullis with uch success that the demand for graduates in mining eology has always been greater than the supply. ullis was followed in the chair by W. R. Jones, its resent occupant.

Under Watts there thus began the production of ighly trained practical geologists, many of whom ow hold chairs in British universities, are members f the Geological Survey, directors of Colonial eological Surveys or consultants to mining and oil ompanies. A roll of the distinguished old students nd colleagues of Watts would include Boswell, racewell, Brammall, Bulman, Dewhurst, Eastwood, roughton Edge, Fitch, Hitchin, Holmes, Ingham, ones, Lepper, Read, Edmondson Spencer, Stubble- eld, Wade, Wayland, Whitehead, Whittard and any more.

In this way, the Geology Department of the Royal chool of Mines, like those of Mining and Metallurgy, as made a very great contribution to Colonial and mperial development, and can justly consider itself worthy part of an Imperial College. While a most mportant function of the Department is this training f high-class geological technicians for the oil and ining industries, just as important a function is the rovision of postgraduate training, especially for ominion, Colonial, Indian and foreign graduates. n many occasions, the student population of the ostgraduate school of the Geology Department has een made up of men from a dozen countries.

Watts was succeeded by Prof. P. G. H. Boswell, ho continued the development of the postgraduate hool and himself established much of the basis of odern sedimentary petrology following his important ork on British glass- and moulding-sands. In 1939, oswell retired for health reasons and was followed by the present head of the Geology Department, Prof. H. H. Read. The codification of views upon granitization and its relation to metamorphism have been the subject of three presidential addresses by Read, and his far-reaching proposals for a genetic classification of rocks are widely acknowledged to merit careful consideration.

Among researches carried out in the Department during the last decade may be mentioned those of Illing on oil geology, Hobson on the compaction of sediments and the properties of clay suspensions, Wood on the algæ, Jones, Brammall and Leech on the etiology of industrial dust diseases, Brammall and Leech on metamorphic granitization as developed in Dartmoor and the Malverns, and many more.

The chief contributions to the advance of geology during the last century from the Geology Department have thus been the establishment of the basic principles, a large output of competent original work, a great production of trained men especially in oil and mining geology fitted for service abroad, and the formation of a strong and varied postgraduate school which attracts students from all parts of the British Empire and from foreign countries.

Mining

The progress during the century in underground activities is no less important, though less known, than that of surface transport from the days of the stage-coach to the most modern motor-car. Especially is this so in the type of mining with which the Royal School of Mines is concerned. Hand-drilling has been replaced by pneumatic-drilling, gunpowder by gelignite and other highly efficient and safer explosives, hand-loading by mechanical scrapers; transport from the working-face of the broken ground is no longer by man-power but by mechanical traction, horse-whins for raising the material to the surface have given place to power winding-machinery, pits of a maximum depth of a few hundred feet have become shafts thousands of feet in depth, and ventilation arrangements of the crudest kind have been replaced by well-planned systems employing large fans of high efficiency, aided, in the deepest and hottest mines—some of which are more than a mile and a half below the surface—by refrigerating plants. These are some, but not all, of the great improvements in the art of mining during the last few decades.

Concerning all these advances, the Mining Department of the School has been and still is the premier place in the British Empire for the training of the mining engineers who, in co-operation with other engineers in their different spheres, have made such progress possible.

The Department was particularly fortunate in its first professor, Sir Warington Smyth. On leaving Cambridge, Smyth spent four years on the mining fields of Europe and the Near East, advising mining companies and collecting representative samples of minerals and rocks from those fields. On his return, he joined the staff of the Geological Survey, became chief mineral inspector of the Office of Works and of the Duchy of Cornwall and adviser to the Crown on all mining matters. His knowledge of geology, and of its practical application to mining, formed the basis on which he built the mining course at the School. Since his day the subjects forming the course have increased considerably in scope with the progress of science; but during the hundred years that have elapsed, the principles of geology have remained a fundamental part of the training of the mining engineer.

Smyth was followed in the chair by Clement le Neve Foster, Herbert Cox, William Frecheville and S. J. Truscott, all men of great eminence in the mining industry before they accepted the professorship. They were able to present to their students first-hand information concerning the mining problems of their day and the improvements they visualized in the future, thus to inspire their hearers to keep abreast of their subject and to retain the international reputation of their forerunners. The standard of athletic prowess set by the first head of the Mining Department—a Rowing Blue—has been maintained by the present head, Prof. J. A. S. Ritson, a former English International Rugby player.

Progress in mining is achieved in the mines, not in college laboratories. Some practical improvement in the art of mining is of almost daily occurrence; and although this is the fruit of research, it is not of the kind that results in the publishing of scientific papers. Thus it is that the strength of the Department lies in its training to bring about these useful practical improvements in the mines rather than in research work carried out within its doors.

In fulfilling this, its most important function, it has been very successful. The excellence of its training has attracted students from all parts of the British Empire. The Department is unique in the number of awards granted to its past students by professional mining institutions, and in the positions of highest responsibility in the mining world occupied by its *alumni*. The A.R.S.M., the diploma awarded to its students, has an unsurpassed reputation in the Dominions and the Colonies, where almost all its students go on leaving the School; and the demand by the Colonial Governments and mining companies for those trained in the Department has always been greater than the supply. Particularly is this so during the past few years, when only a small fraction of the posts offered could be fulfilled.

Metallurgy

The first English text-book on metallurgy was written by Dr. John Percy, the first professor of metallurgy at the Government School of Mines and of Science applied to the Arts, later to be known as the Royal School of Mines. Percy has been truly described as the 'father of English metallurgy', and it could well be stated that for the first decade of his professorship, his department was the cradle in which British metallurgy was nurtured. Among the results of his many successful researches was the adoption for the Patera process in 1858 using sodium thiosulphate for the leaching of silver ores.

In those early days, phosphoric iron deposits remained useless as a source of iron, for no method was known by which the deleterious phosphorus could be removed. Percy Carlyle Gilchrist, in association with his cousin Sidney Gilchrist Thomas, and inspired by John Percy, carried out experiments which ultimately established the basic Bessemer process for converting phosphoric pig iron into good-grade steel. The first patent was taken out in 1877 and from it was developed the modern basic steel industry.

Percy was professor during 1851–80, and was followed by Sir William Chandler Roberts-Austen (1880–1902), an exceptionally able and inspiring teacher, who fostered the growth of physical metallurgy—then in its babyhood—to such a degree that his team of researchers, which included D. G. Bengough, O. F. Hudson, W. H. Merrett and Stansfield, made notable advances in the study metallography.

William Gowland, then a well-known authority the metallurgy of copper, followed Roberts-Aust and was professor during 1902–9. He completed t Fifth Alloys Research report, the first four havi been published by his predecessor.

For the five following years, 1909–13, the ch was occupied by William A. Carlyle, who had be manager of Rio Tinto Mines and smelter. His wi experience in industry enabled him to impress on h students the importance of understanding practic operations on a large scale.

Sir Henry Cort Harold Carpenter was profess from 1913 until his tragic death in 1940. Under h direction, considerable advances were made in t study of corrosion of metals and, in collaborati with Miss Elam (Mrs. Tipper), the first single crysta of aluminium were produced, thereby providing da which have proved of fundamental importance. chairman of a large number of Government cor missions and research institutions, he was able exercise great influence in promoting the advanc ment of knowledge in a wide variety of metallurgic operations.

In the course of the century, the Department h produced many metallurgists of outstanding eminenc and professors who, in their turn, have grafted o their universities the courses initiated at their *Alm Mater*. Among its brilliant students were C. Bannister, C. V. Boys, A. J. Brett, A. C. Claude Sir Lewis Fermor, P. C. Gilchrist, F. W. Harbor O. F. Hudson, W. F. Hume, Henry Louis, A. McCanc B. McNeill, T. A. Rickard, E. Riley, Sir Thoma Rose, S. W. Smith, A. Stansfield, T. Turner, an E. A. Wraight.

The Royal School of Mines, proud of its achieve ments, is beginning its second century in a spirit high endeavour, fully confident that it will continu to produce the highly trained geologists, minin engineers and metallurgists who during peace an war have served Britain and the British Empire wit conspicuous success.

THE ALLIED PLAN FOR EDUCATION

By Dr. E. F. ARMSTRONG, F.R.S.

THE United Nations Educational, Scientific an Cultural Organisation (U.N.E.S.C.O.) commence its deliberations in London on November 1 and wa able to have its constitution agreed and signed by the representatives of forty-four nations on November 16. The principal object of this Conference wa to draw up the constitution of the new body; th delegates attended primarily, therefore, in a diplomatic rather than an educational capacity.

Perhaps the outstanding achievement to many o us is the inclusion of the word 'Scientific' in the titl as well as in all pertinent places in the text. Scienc has now world recognition as an equal partner i the great task of world educational reconstruction

It is generally recognized that the failure to se up an educational body on the same lines as th International Labour Office after the First Worl War was a serious omission. The remarks of th ime Minister, Mr. Attlee, at the first session of) Conference, form the first sentence of the preible to the constitution "that since wars begin in ə minds of men, it is in the minds of men that ə defences of peace must be constructed". It is education alone that men of all classes in all untries can get to know and understand one anher. Hence the general view among delegates that ey were forging the best possible instrument of ace—a peace based on the intellectual and moral idarity of mankind.

The first and most immediate object of N.E.S.C.O., when it begins its real work, must to bring help to education in the backward untries. A backward citizen is not necessarily a d citizen, but his country will be stronger in the easure that he ceases to be illiterate.

People are thinking to-day as perhaps never before. ere is universal agreement on a higher standard of e for all, though silence about the fact that it reires education both to attain it and enjoy it. Some vocate a classless society without realizing the possibility of there being any such thing. The ascist State, whether of the extreme right or the treme left, advocates the vice of mass thinking; ientific workers lead in demanding freedom of ery kind. Pessimists proclaim that nothing will er be the same again, while the optimists hope change human nature by 'order in council'. The uth is that we are unable to decide between what permanent and what is ephemeral, or as Charles organ has so admirably said, "the middle truth pears to be that in all societies and at all times ere are both constants and variables, and that hat gives to an age its distinguishing character the relationship, the friction between them".

But this article is primarily to deal with the effect the new organization on science, national and ternational. It can be profound, but the future ust be shaped by our own efforts; it cannot and ust not be left to others while we sit back and iticize.

The U.N.E.S.C.O. originated, as is well known, in art from the Conference of Allied Ministers which egan work in London on the initiative of Mr. R. A. utler, then Minister of Education, in October 1942. July 1943 it set up a Science Commission. The rimary work of the Allied Ministers Conference was make preparations so as to be ready to aid the ssential work of educational and moral reconstruction hen their countries were freed; hence the original sk given to the Science Commission was to work ut the requirements for scientific and laboratory quipment. A general picture of the problem as a hole was obtained and, for the first time, an idea the magnitude of the scientific equipment of the ountries concerned was gained. As a result of their ork seventy-six detailed inventories—of many housands of items—have been compiled. These rm a unique catalogue of the necessary equipment f laboratories for a wide range of sciences such as ad never before existed. They will form valuable orks of reference for many years to come and greatly cilitate both the task of rehabilitation and the etting up of a laboratory in any part of the world.

Apart from this specific achievement, the Science ommission has taken all possible steps in a variety f directions to be able to guide and assist the restoraon of science at all levels in the occupied countries, nd it can form a basis for the science division of the reparatory Commission of U.N.E.S.C.O.

Perhaps it is appropriate here to chronicle that the Conference set up a Preparatory Commission to take all necessary steps to bring the new body into physical being and start its work, in particular to get ready the agenda for the first real meeting, which can only take place after a sufficient number of nations have ratified their acceptance of the constitution. When this happens the home of U.N.E.S.C.O. will be Paris. In the meantime Sir Alfred Zimmern is acting as secretary and the business is being conducted from London.

Two different themes were in the minds of all the delegates: one, the legalistic drafting of the constitution; the other, humanitarian, the need to help in rehabilitation of the devastated countries. It required skilled conduct on the part of the chairman of the various meetings to keep the two subjects separate in the discussions. Finally, the rehabilitation aspect was referred to a Technical Committee to be set up by the Preparatory Commission and to come into being at once.

The last session of the Conference was devoted to restoration and closed on a high note of urgent need; the meetings which followed immediately concerned themselves with procedure and oratory and involuntarily brought to mind those words of Macaulay:

"Those behind cried forward,
Those before cried back."

Admittedly, it is difficult to see how best to ensure the provision of aid since this is dependent inevitably upon action by individual nations or existing international relief organizations.

The Conference had before it as the working document a White Paper prepared by the Allied Ministers Conference which substantially was adopted. In this White Paper the word 'Science' was lacking, but its insertion was urged by the United Kingdom delegation largely on the insistence of Miss Ellen Wilkinson, who so efficiently acted as president of the Conference. The proposal met with no serious opposition. Arguments as to whether science is included in 'Culture' are interminable and serve no useful purpose. The nations of the world were concerned, not Britain alone, and to them the inclusion of the specific word 'Science' had a real meaning.

Delegates from the South American countries, from Turkey, China, Egypt and many other, including the Arab countries, all gave the assurance that new status had been given to teachers of science so that their powers would be increased and their prestige enhanced. The same consequence can be made to apply even in Great Britain, where science is still largely an extra, though honourably bracketed with music and dancing!

Charles Morgan writes of "a confluence of ideas flowing from the nations into the stream of civilization". The opportunity now exists to make science supply some of the tributaries of this stream!

Nature, in its issue of November 15, gave full space to the views expressed by some of our leaders regarding the proper future organization of international science, so that there is no point in expressing further views of a detailed character.

The constitution of U.N.E.S.C.O. is permissive, as every well-drafted instrument should be. 'May', for example, in Article 8, enables it to co-operate with outside international bodies presumably of repute, whereas 'shall' is mandatory and forces recognition of any body with headed stationery and a brass plate on the door.

The primary and indeed essential need is for science to be represented from the very beginning on the Secretariat of U.N.E.S.C.O. The secondary action may well be for us, first nationally and then internationally, to make the existing or new scientific organizations of various types both representative and efficient so that they can claim recognition from U.N.E.S.C.O. at an early stage. The proposals put forward by the Association of Scientific Workers, as representing the work which the scientific division of U.N.E.S.C.O. should do, are admirable but they would take several years to bring to fruition, and demand a large and highly qualified administrative staff at a moment when there is a great dearth of scientific workers for productive work. Moreover, the question arises whether all these matters should be handed over to bureaucrats, for that is what they will become, even though they started as men of science. The docile are not always the virtuous. Is it not wiser to maintain the freedom which we cherish, which some think we are in danger of losing, and organize these things for ourselves while becoming closely affiliated to the world organization ?

There is so much to do to-day that we are accustomed to priorities in every sphere of activity. U.N.E.S.C.O. must have priorities, some undoubtedly far higher than the claims of advanced science : this is the main reason why we must do some things for ourselves if they are to be done soon.

Happenings the world over rightly interpreted may be taken as evidence of strength in our civilization. The responsibility for the recreation of the moral life of the world will fall heavily on us; in this we dare not fail. As R. A. Butler wrote the other day, the Conference "must ensure that the world of Education, like that of Science, does not become the plaything of purely Governmental machinery, either in any one country or in any international organisation".

In the next few months U.N.E.S.C.O. will have to establish its organization. It has a precedent in the International Labour Office. The Executive Board is representative of eighteen governments and elected by the Conference ; there is to be a director-general and a permanent secretariat. Perhaps it should at once break down its work into sections, of which science will undoubtedly be one. Men of science should proceed without delay to set out in clear and, above all, practical terms, avoiding too great a length, the work and problems which this Science Section should envisage as its first tasks. It must be remembered that the non-scientific workers have still to be educated regarding the nature and the value of the help which the scientific attitude of mind can give them ; at present they are sceptical, even suspicious of the motives of men of science and confused by the scientific habit of speaking with so many contrary voices on any subject.

The Conference was well attended, several countries sending large and influential delegations. As always on these occasions, perhaps most was effected by private conversations or smaller meetings, among which were several for the scientific delegates.

Many delegates were closely connected as teachers with education in their own countries, including some of the more backward in the educational sense. They were outspoken in the benefits which U.N.E.S.C.O. could give them : money spent on education instead of armies, a life in which cultural interests, the drama, art, science and literature could play a part instead of power politics and the fear of future war; a life in which mutual understanding and knowle instead of ignorance of each other's ways and li could be developed; a life of travel and intercha of visits (extending over weeks and months) children, students, teachers, professors, resea workers, all men and women of sympathy and go will promoting peace and an international outl instead of narrow nationalism and suspicion; a in which technical progress was for the service man and not for his destruction.

INSTITUTION OF METALLURGIST

INAUGURAL MEETING

AS a craft, the metallurgical art is of the great antiquity : in the speculative development natural science, the metals have played an importa part. During the Middle Ages, the Guilds and Live Companies exercised a beneficial influence in manding proofs of competence from the craftsm working with metals; but as the importance of th bodies decreased, this control diminished, and sin then, until the last few weeks, there was no organi tion, in Great Britain at least, which was responsil for certifying metallurgists as being professiona competent. University qualifications are clear pro of this ; but there are many who, for reasons outsi their own control, have never had the opportuni of obtaining such training or 'hall-mark'.

In the Iron and Steel Institute and the Institu of Metals, Britain possesses two bodies which ha done great service to the metallurgical industrie and to the community in general, as the avenu through which metallurgical research and develo ments have been made known ; but membership neither is recognized as proof of more than intere in the ferrous or non-ferrous metals.

For some years, there has been a growing feelir that a strictly professional body, somewhat simil to those which exist for chemists and engineers, w needed, and the two Institutes have had the matt under consideration. It was ultimately decide that the demand would be best met by th establishment of a new organization, admitting onl qualified workers in the field of metallurgy, an having functions supplementary to, and independen of, the two existing metallurgical institutes.

On September 15, 1945, the new Institution Metallurgists was incorporated and licensed by th Board of Trade, and on November 28 the inaugura meeting was held, under the presidency of Dr. H Moore, at 4 Grosvenor Gardens, London, S.W.1, th offices of all three bodies. Attended by metallurgists of repute in all branches of the art and science— the presence of Prof. T. Turner, the *doyen* of Englis academic metallurgists, gave, perhaps, the greates pleasure—and with the support of representatives o very many similar scientific and professional societie the support and collaboration of which will b most welcome, the Institution was launched unde conditions of the most complete harmony.

After outlining the reasons for the formation o still another society, Dr. Moore expressed his and th Institution's satisfaction at the presence of so many distinguished guests, and pointed out that th Institution was still under the control of a 'caretake government' until the first general election of officer to be held in the earlier part of next year. He the introduced the Hon. R. G. Lyttelton, treasure tho Iron and Steel Institute, who on behalf of one he 'parents' wished the Institution every success.

W. T. Griffiths, president of the Institute of tals, followed and reminded the meeting of the k done by the late Dr. T. Swindon in the early s of the discussions which had that day come fruition. Throughout, the assistance of the two ent organizations was most cordially acknowledged. The value of the work of Dr. Moore himself, and that of Mr. K. Headlam-Morley, the secretary of both Institutes and of the new Institution, was stressed by Dr. J. W. Jenkin, vice-president, without which the formation of the Institution would have been considerably delayed.

To these gentlemen and to the two Institutes, the Institution of Metallurgists owes a very deep debt.

NEWS and VIEWS

ence and Reconstruction

In addressing the Manchester Joint Research uncil on "Science and Reconstruction" on Decem- 6, Sir John Anderson referred to his own early eer to emphasize that a good grounding in natural ence can be a passport to the higher Civil Service l that public administration does provide scope, art from the professional or specialist grades, for n with a scientific training. Sir John associated nself with the view that the restoration of the nomic life of Britain, and even the maintenance pre-war standards of living, depends on building our industries to a level of efficiency higher than er before attained; and in support of this view referred to some outstanding British technical hievements during the War to establish his contion that, while we have lagged behind in the past d men of science have to get rid of prejudice ainst applied science, the prognosis for the application of science in industry during the period of reconuction is extremely favourable. Considering what still needed, Sir John dealt first with the question personnel. The output of scientific workers is low that which the real needs of the country mand, and too little was made of the importance scientific and technical education during the ssage of the Education Bill last year; indeed, the eds of industry may at first have to give way to ose of the universities. Urging the importance of eparing a quantitative and qualitative estimate of ture requirements of trained men and women, Sir hn welcomed the appointment by the Lord President of the Council of a committee to deal with the estion of scientific man-power and also pressed accelerating the release from the Forces of trained en of science and students.

Dealing next with the question of finance and the cent increased Government grant to the universities Britain and to the new allowances in regard to x relief for research expenditure, Sir John instanced number of recent university endowments by dustry as illustrating the value of such relief. He lieves that so far as financial aid is concerned, we ve a framework within which all that is required n be secured. The efficient use of the limited sources of Britain, however, demands the best ssible organization, and here Sir John suggested worthy of exploration a number of questions in gard to remuneration, mobility and interchange of aff and information or ideas, pensions schemes and e like on the lines of the recommendations in the cent Barlow Report on scientific staff. Research applied science in teaching institutions should not discouraged, though they should not be encouraged undertake agency or contract work. The adntage of allowing some fundamental research in dustrial research establishments should be recognized, and industrial associations might discuss with representatives of the universities and Government research organizations long-term programmes of research and what fundamental researches can most profitably be conducted in Government establishments or centrally in selected institutions.

Sir John Anderson unhesitatingly rejected the idea of a Minister of Science and suggested that the Lord President of the Council should be formally recognized as the Minister responsible for dealing, on behalf of the Cabinet, with all general scientific questions in which the Government is concerned, including problems of organization and arrangements for Commonwealth or international conferences. The Scientific Advisory Committee should be placed on a peace-time footing with some extension of staff, as the principal adviser of the Lord President and the Cabinet in scientific matters. Sir John would also create a special section of the Cabinet secretariat to assist the Lord President in the discharge of his new responsibilities. Finally, referring to the investigations into atomic energy, Sir John said that nothing had been discovered to justify the expectation that the energy released by an atomic explosion could be used directly as a source of industrial power. The only practicable method appeared to depend on the conversion into heat of the energy released by a controlled process of nuclear fission. The vast range of new radioactive substances, including radioactive forms of common elements used in medicine, which the new devices provide is probably much more important and beneficial and may bring a revolution in medical science.

Industrial Research in Great Britain

The Industrial Research Bill introduced into the House of Lords on November 29 by Lord Barnby was withdrawn after a speech by Lord Pakenham in which he indicated that although there was no active opposition to the principle of an enabling Bill, only about a dozen industries out of the eighty or ninety consulted by the Government on their post-war problems had indicated that they might take advantage of such legislation to finance any of the joint activities mentioned. Owing to the extreme pressure on parliamentary time during the present session, the Government would be unable to give facilities for the Bill; but whatever might be the position in the future, finance is not at present the main trouble. After referring to the announcement of the Lord President of the Council in his speech on November 6, Lord Pakenham emphasized that the Government appreciates that in some industries a statutory levy would give research associations the security of revenue necessary to allow them to plan useful long-term research and would have other advantages. Accordingly, the Government had the matter still much in mind, along with the allied question of statutory levies to finance other desirable co-operative activities. The Government does not wish to discourage industries which have plans under consideration from proceeding to work them out in detail, even if those plans will ultimately need statutory power to give effect to them. Emphasizing the importance which the Government attaches to a rapid improvement in the scientific basis of our industrial production, Lord Pakenham said that the Government could do a little to help in that matter; but primarily such improvement must depend on the willingness of industrialists themselves to devote resources to research, and it must depend still more on their willingness to exploit the results of scientific research.

Dr. A. D. Imms, F.R.S.

Dr. A. D. Imms has retired from the readership in entomology at Cambridge, which he had held with distinction since 1931. Dr. Imms was the first holder of this readership, the establishment of which resulted from an endowment by the Rockefeller Foundation, made with the avowed intent of strengthening in Great Britain those sciences which are fundamental for agriculture. The appointment of Dr. Imms seemed almost inevitable. After taking his degree in London, Dr. Imms held an 1851 Research Scholarship at Corpus Christi College, Cambridge, during 1905–7, and then took up the appointment of professor of biology in the University of Allahabad; for two years, during 1911–13, he was forest zoologist to the Government of India, after which he became reader in agricultural entomology at Manchester, establishing there a tradition for entomological research which has lived on. But it was not until his transfer to Rothamsted in 1918 as chief entomologist that his full stature came to be appreciated. In 1924 Dr. Imms published his "Text-book of Entomology", and at once he became recognized as the leader of entomology in Great Britain. This excellent book has gone through three editions, and is almost as widely used in the United States as it is in Britain. "Recent Advances in Entomology" followed in 1931, and during the War Dr. Imms produced an admirable "Introduction to Entomology". The influence of these books has been immense, and will long continue. It is good to know that Dr. Imms intends to pursue his literary work in the milder climate of Devon, and we may hope that the entomological world at large may long enjoy what Cambridge has regretfully lost.

Dr. V. B. Wigglesworth, F.R.S.

Dr. V. B. Wigglesworth has been appointed to the readership in entomology in the Department of Zoology, Cambridge, vacated by Dr. A. D. Imms. In addition, he is in charge of a Unit of Insect Physiology of the Agricultural Research Council. After some postgraduate work in biochemistry at Cambridge, Wigglesworth held posts in the Department of Entomology at the London School of Hygiene and Tropical Medicine, during 1921–43. The Department was under P. A. Buxton, who was interested in precise field-work on the ecology of insects, and Wigglesworth made complementary studies on physiology, exploring many sides of the subject, including the behaviour of insects. His work went deeply into the pure science, the view being taken that a proper understanding of physiology is one of the foundations of applied entomology. He shov himself a master of the carefully planned experim and of the simple technique. Not infrequently experiments with insects have proved to be importa contributions to general physiology. His book, "T Principles of Insect Physiology", first published 1939, is an important contribution to biologi science.

Dr. Kenneth Mellanby

Dr. Kenneth Mellanby has been appointed the University readership in entomology tena at the London School of Hygiene and Tropi Medicine in succession to Dr. Wigglesworth from October 1. During 1930–36 Dr. Mellan was engaged in research work at the London Sch of Hygiene and Tropical Medicine, and in 19 he was elected Sorby research fellow of the Ro Society. He joined the R.A.M.C. in 1943, but w released in 1944 in order to proceed to South-E Asia for research on behalf of the Medical Resear Council.

Earthquake in the Arabian Sea

The greatest shock ever recorded by the Rivervi Observatory, Australia, was registered by seism graphs throughout the world about 10.6 p.m. G.M on November 27. The epicentre may have been ne lat. 24° N., long. 64·5° E., about 180 miles fro Karachi in the Arabian Sea. *The Times* corresponde at Delhi suggests it may have been near the doul ridge which encloses an 8,000-ft. deep gully on t bed of the Arabian Sea. The ridge was first plott by the John Murray Expedition of 1933–34 and probably a continuation of the Kirthars Range b tween Sind and Baluchistan. Mr. E. W. Pollard, the Isle of Wight, recorded the earthquake 22h. 06m. 24s. G.M.T.

At Karachi the shock was accompanied by rumbli but no damage has been reported except for a fe broken windows. The earthquake was felt througho the Las Bela State of Baluchistan, and at Banjiguar Baluchistan. A tremendous sea wave, presumab caused by the earthquake, occurred about the sar time at several places on the coast. In the Bomb suburbs of Juhu and Versova boats were smash at their moorings and some people standing on t shore were carried out to sea. The bodies of thr women were recovered. It is reported in *The Tim* that the bodies of seven of the nine persons caug by the wave at Mahalaxmi, opposite Bombay's rac course, have been recovered. Most of the victi appear to have been caught on the causeway co necting an ancient Muslim mosque, which is bu on a rocky outcrop, with the mainland. This caus way is usually under water at high tide. The wa was most severe on the coast of Makran, north-we of Karachi. At Pasni a number of people are r ported to have been washed away and the post a telegraph office together with other buildin damaged. The Government of India has vot one lakh of rupees for the relief of victims. The da age and loss of life, though great, is thought at t moment to have been estimated too high, and offic figures are awaited. The officer in command of t Royal Indian Navy warship *Hindustan*, the fi relief ship to reach the coastal area in question, h signalled news of two new islands in the Arabian S about 180 miles west of Karachi. They are stat to have appeared after the recent earthquake a be three miles apart. One has an area of about one square mile and the other one and a half square miles.

In the past, a great earthquake occurred in the tate of Cutch on June 16, 1819. This earthquake aused damage over a vast area and extensive changes in level in the crust of the earth. In Bhuj early 7,000 houses were overthrown and 1,140 bodies aken from the ruins. Half the town of Anjar was also destroyed with large loss of life. More recently, earthquakes have also occurred in Baluchistan in 919 and 1931 (*Nature*, April 27, 1935, p. 661). It ppears fortunate that the recent earthquake occurred eneath the sea some miles from land, as otherwise, with a shock so tremendous, without doubt there would have been enormous damage to property and oss of life.

A Biological Council

MANY biologists have felt for some time past that he activities of the specialized societies to which hey belong remain largely unknown to other biologists who happen to belong to different societies or associations, although often the activities of these other societies are of direct interest to them. The officers of various biological societies have frequently felt the need for more information about the arrangements made by their fellows so as to avoid unnecessary clashes of dates of meetings or duplication of discussions on subjects that might advantageously form the basis of a joint meeting. In an endeavour to provide some common meeting ground for the representatives of the various biological societies, the Committee of the Biochemical Society in the autumn of 1944 called an informal meeting of representatives of a few societies which it was thought might be interested in the proposal. In all, three meetings, attended by representatives of fourteen biological societies, were held afterwards in the rooms of the Royal Society.

It was finally decided that a Biological Council should be formed consisting of the representatives of the various societies which were sympathetic to the scheme. The first meeting of this Council, at which Sir Henry Dale took the chair, was held recently in the Linnean Society's rooms. Dr. W. P. K. Findlay, of the Forest Products Laboratory, Princes Risborough, Dr. W. T. J. Morgan, of the Lister Institute of Preventive Medicine, London, and Prof. J. Z. Young, University College, London, were elected secretaries. While the immediate objects of the Council will probably be limited to such matters as the dates and subjects of the general meetings of societies, it is envisaged that the scope of the Council's work may enlarge and that many editorial and other problems relating to the societies' publications may fruitfully be discussed in common.

Plant Pathology in Palestine

ON the occasion of his seventieth birthday in November 1944, Prof. Chaim Weizmann was presented with a volume of researches by members of the Division of Plant Pathology of the Agricultural Research Station, Rehovoth, Palestine. This volume, describing researches carried out under war conditions, testifies to the zeal and energy of the phytopathological staff of the Station. The subjects dealt with cover a wide range, and include diseases of lettuce, beans, cucumbers, tomato, potatoes, citrus, cereals, clover, apple and pear scab, and fungicides. All the papers have since appeared in the *Palestine Journal of Botany*, but the collection brought together is a worthy tribute to a great leader. The remarkable progress in agriculture effected by the Jews in Palestine has no doubt been greatly fostered by the help and assistance afforded by the work of the Agricultural Research Station at Rehovoth. Of the many interesting items mention may be made of four only: a rare parasite of potatoes is constituted by powdery mildew, due to an unidentified species of *Oidium*, which first became epidemic in 1941, and again in 1942 and 1943; the occurrence of the apple and pear scab in all parts of Palestine but on local varieties only, as the European varieties are some weeks later in growth and regularly escape infection; the novel and ingenious suggestion of using the overhead system of irrigation, now largely in vogue in Palestine, for the application of fungicides; and the occurrence of *Ustilago nigra* on barley, the first record of this species of smut outside North America, and of immediate practical importance as this pathogen is susceptible to seed disinfectants.

British Radio Industry

THE fundamental scientific principles of radiolocation and the startling results obtained from its application during the War have now become common knowledge. While the conception of this important new weapon is a tribute to British scientific research, and its success in practice demonstrates the ability of the Fighting Services to utilize a highly technical development, there is a necessary intermediate factor, which must not be forgotten, in the form of the design and production facilities available during the time of the country's direst need. The Radio Industry Council has dealt with this last aspect of the subject in a booklet recently issued under the title "The British Radio Industry in War and Peace" (Radio Industry Council, 59 Russell Square, London, W.C.1). The object of this small publication is to tell the world what British men of science, engineers and workpeople have accomplished in the past five years in the application of the whole field of radio technique to war-time requirements, and the manner in which the experience gained during this terrific effort will be applied to the post-war development of broadcasting and television receiver production.

The British radio industry, which in 1935 produced nearly two million broadcasting receivers for ordinary listeners, was the main source of supply of the technical personnel required by the Services during the War to instal, operate and maintain radiolocation and communication equipment. In spite of this loss of some of its most valuable workers, the radio industry was called upon to supply, at high pressure, tremendous quantities of equipment and components of all types. A typical and impressive example of the scale of the radio equipment required is given by the fact that in any one of our thousand bomber raids many thousands of valves, cathode ray tubes and other electronic devices were in the air with those machines; while at the same time there were further very substantial quantities of all kinds of co-operating equipment in use on the ground. The Radio Industry Council has developed largely from the industry's war-time growth, and it is actively engaged in co-ordinating and furthering the interests of the whole radio manufacturing industry through the four independently constituted associations which deal respectively with the manufacture of valves, components, complete equipments and with general radio communications and electronic engineering.

An Abstracting Service for Human Biology

THE trustees of *Biological Abstracts* announce the establishment, beginning in January 1946, of a new section—Section H, specially assembled Abstracts of Human Biology—intended for anthropologists, sociologists, psychologists, neurologists and psychiatrists, students of child development and human welfare, and students of man generally. The new section will be an assemblage of all abstracts published in *Biological Abstracts* dealing with the broad field of human and social biology. Biological studies on human inheritance, population and fertility, endocrine and neurological factors affecting growth, development and human personality, alcoholism and drug addiction, and nervous disorders and mental deficiencies, and broad nutritional and epidemiological studies affecting human welfare, are some of the many fields that will be covered. Further information may be obtained from Mr. H. I. Anderson, Biological Abstracts, University of Pennsylvania, Philadelphia 4, Pennsylvania.

Survival of a Fish after a Major Injury

A POPULAR article by Elizabeth C. Pope in *The Australian Museum Magazine* (8, No. 11, 383) records the survival of a specimen of *Meuschenia skottowei* after the loss (at some previous date in its existence) of three fifths of the tail end of its body. The fish was swimming in the customary position when it was caught in Port Jackson. A photograph of the specimen shows an interesting modification of what, originally, must have been mere remnants of the dorsal and ventral fins. These appear to have grown backwards and round the severed end of the body in order, apparently, to compensate for the loss of the tail as a propelling organ. Dissection showed that the back had been severed clean between vertebræ, and in such a position that little more than the head remained. Most of the gut, though intact, was found to be displaced, and, though the internal organs were crowded, the swim-bladder appeared normal. At least two of the major blood-vessels must have been severed at the time of the accident; but death by hæmorrhage was evidently prevented by crushed tissue sealing the cut ends.

University of London Appointments

DR. KARL MANNHEIM has been appointed to the University chair of education tenable at the Institute of Education as from October 1, 1945. Since 1933 he has been lecturer in sociology at the London School of Economics and since 1941 he has been attached to the staff of the Institute of Education.

Dr. Walter Freudenthal has been appointed to the University readership in dermatological histology tenable at University College Hospital Medical School as from October 1, 1945. Since 1934 he has been research worker and assistant to the Dermatological Department of the School.

The title of professor emeritus in morbid anatomy in the University has been conferred on Prof. G. W. de P. Nicholson, who was University professor of morbid anatomy at Guy's Hospital Medical School during 1922–44.

Dr. D. M. Newitt, reader in chemical technology at the Imperial College of Science and Technology since 1937, and since 1941 director of scientific research of the Inter-Services Research Bureau, has been appointed to the Courtaulds chair of chemical engineering tenable at the College as from October 1.

Dr. Alan Moncrieff, of the Middlesex Hospital an the Hospital for Sick Children, has been appointe to the Nuffield chair of child health tenable at th Institute of Child Health as from January 1, 194

Royal Geographical Society Christmas Lectures

THE two Christmas lectures of the Roya Geographical Society will explain in non-technica terms the evolution of survey and map-productio methods down to the advances achieved during th War. On December 31, Major C. A. Hart will spea on "Modern Maps and how they are Made", and o January 4, Dr. Edward Lynam, in charge of the Ma Room of the British Museum, will deal with som "Early Map Makers", and early methods of surveyin from the time of the fourteenth century. The lectur will be supplemented by an exhibition which wil be open during December 31–January 5 in th Society's House, Kensington Gore, London, S.W.7

Physical Society's Exhibition

THE thirtieth Exhibition of Scientific Instrument and Apparatus, arranged by the Physical Society will be held at the Imperial College of Science an Technology, Imperial Institute Road, South Kensington, S.W.7, on January 1 (2.30 p.m.–9 p.m.), January 2 (4 p.m.–9 p.m.) and January 3 (2.30 p.m.–9 p.m.). The leading manufacturers of scientific instrument will be exhibiting their latest products in the Trade Section. The Research and Educational Section wil contain contributions from research laboratories, and experiments of educational interest. Discourses will be delivered on January 1 at 5.30 and 8.15 p.m., on "The Optical Industry in the War", by Captain T. Martin; on January 2, at 5.30 and 8.15 p.m., on "Radar", by Sir Edward Appleton; on January 3, at 5.30 and 9 p.m., on "Modern Plastics and Cements", by Dr. J. C. Swallow. Admission to the Exhibition is by ticket only. Members of institutions and scientific societies may obtain tickets from their secretaries; tickets may also be obtained direct from the Exhibition Secretary, 1 Lowther Gardens, Exhibition Road, S.W.7.

Announcements

PROF. ARTTURI VIRTANEN, of the Biochemical Institute, Helsinki, has been awarded the Nobel Prize for Chemistry for 1945.

THE managers of the Royal Institution have appointed Prof. Eric K. Rideal, professor of colloid science in the University of Cambridge, to be Fullerian professor of chemistry in the Royal Institution and director of the Davy Faraday Research Laboratory, in succession to Sir Henry Dale, who retires from both posts on September 30, 1946.

PROF. H. A. KREBS has received a message from Dr. T. Bucher, who worked with Prof. Otto Warburg, stating that Prof. Warburg is alive and well. Apparently Prof. Warburg went to his country house on the Island of Rügen in January 1945, and returned to Berlin in June.

THE foundation members of the newly formed Medical Academy of Sciences of the U.S.S.R. met recently to vote for the first elected members and corresponding members of the Academy. Among those elected to membership were A. E. Braunstein, N. R. Rogansky, R. R. Timofeevsky, P. K. Anochin, D. N. Nasonov and N. F. Gamalea.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

A Simplified Chemical Notation

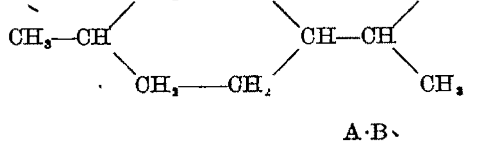
Some twenty years ago and more I suggested an abbreviated notation to a few chemical friends, who old me that the old method was all they needed, and was too well established to be disturbed. But he thing has recurred to my mind, and I am encouraged to think there may be something in it after all.

Suppose a tetrahedral molecule, with C in the middle, and four H-atoms, not at the apices, but on he *facets* of the tetrahedron; and let us call it A. Lay one such molecule on another; two facets (or two H-atoms) are thereby obliterated. A was CH_4, A_2 is now C_2H_6, and A_n is the whole series of the paraffins. It is obvious, and at the root of the matter, that A, which began as CH_4, may signify CH_3, CH_2, or even C, according to its place in a arger molecule.

Suppose another tetrahedron, on one face of which he H-atom is replaced by —OH, and call it B; his is methyl alcohol, AB is ethyl alcohol, and A_nB is the series of monohydric alcohols. The isomers of these explain themselves; for propyl alcohol (A_2B) may be AAB or ABA, and so on. The primary alcohols are A_nB, the secondaries are A_nA_mB, and the tertiaries are $A_nA_mA_pB$. The polyhydric alcohols have the general formula B_n; glycol is B_2, glycerol s B_3, and so on.

A third tetrahedron (D) has two of the four H-atoms replaced by O; it is formaldehyde, and A_nD s its homologous series. Acetone is formaldehyde to which two methyl groups are added on; its formula is ADA, and that of the higher ketones is A_nDA_m. Formic acid (CHOH : O) becomes a fourth tetrahedron, E; acetic acid is AE, and A_nE is the series of the fatty acids.

To include the nitrogen compounds we use a letter *N*) for the ammonia radical; methylamine is A*N*, dimethylamine A_2N, and so on; but we must distinguish ethylamine, AA*N*, from A_2N. It will be useful to have a single letter (K) for the benzene ring; but we may deal otherwise with the cyclic compounds. For as A_n represents a linear, or successive, series of methane groups, so let some such symbol as $\{A_n\}$ represent the same in cyclic form. $\{A_6\}$ will represent the single-bonded cyclic C_6H_{12}; and, by a further convention, $\{\{A_6\}\}$ may represent the double-bonded cyclic C_6H_6, that is, the benzene ring itself. As an example of a cyclic formula, take menthol (the alcohol):



This we may now write as $A\cdot A\genfrac{}{}{0pt}{}{A\cdot B}{A\cdot A}A\cdot A_3$, or as $A\{A_5B\}A_3$. But enough of examples.

D'Arcy W. Thompson.

St. Andrews.

Life-time of the Neutral Meson

The circumstance that neutral mesons have thus far escaped all attempts at experimental detection can, if one assumes these particles to exist at all, be accounted for by ascribing to them a very short lifetime, τ_n, where τ_n refers to the rest system of the neutral meson. In fact, τ_n should be smaller by several orders of magnitude than the corresponding quantity for charged mesons, τ_{ch}.

It has been pointed out by Sakata and Tanikawa[1] that a neutral meson can decay into p photons, $p \geq 3$, a process which gives the desired connexion $\tau_n \ll \tau_{ch}$: for $p = 3$ they find $\tau_n \sim 10^{-16}$ sec. $\sim 10^{-10}\tau_{ch}$. However, the reasoning of these authors would not seem to be conclusive as it involves, contrary to other life-time calculations, the cutting off of a divergent integral, namely, that of the momenta of the protons occupying negative energy-levels. Thus so long as the mystery of the divergences in quantum field theory has not been solved, the above numerical result remains questionable. Therefore, it may be of some interest to inquire whether there is another way of accounting for the short life-time of neutral mesons which does not involve cut-off integrals.

Clearly such a possibility exists: we have merely to assume, first, that in close analogy to the decay of charged mesons, the neutral meson disintegrates according to (the notation will be obvious)

$$Y^0 \rightarrow e^+ + e^- \text{ , } Y^0 \rightarrow n + n' \text{ ; } \quad . \quad . \quad . \quad (1)$$

secondly, that

$$\frac{g_{ch}^2}{\hbar c} \ll \frac{g_n^2}{\hbar c}, \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

where g_{ch} (g_n) denotes the strength of the coupling of charged (neutral) mesons with the electron-neutrino field.

In the customary treatments, one puts instead of (2)

$$\frac{g_{ch}^2}{\hbar c} = \frac{g_n^2}{\hbar c} \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

(which, together with (1), would yield $\tau_n = \tau_{ch}$). The only reason for using (3) is analogy. In fact, relations similar to (3) for couplings of mesons with nucleons are employed in symmetrical theories of nuclear forces, where they find their experimental justification in the charge independence of nuclear forces. But has this analogy any physical background?

The fact that there exists a coupling between the various meson fields and the electron-neutrino field means that there are forces between electron-neutrinos, of the exchange (ordinary) type due to charged (neutral) mesons which can, to a first approximation, be computed by the second-order perturbation formula

$$\sum_i \frac{H_{Ai}\,H_{iF}}{E_A - E_i}.$$

In the nucleon case, the same formula can be used. But whereas it is there possible (to a first approximation with respect to v/c) to neglect the dependence of $E_A - E_i$ on the energy of the nucleons (neglect of recoil), this is impossible in the case of the electron-neutrino because the quanta (virtually) created by the electron-neutrino are heavy compared with the particles by which they are created: the electron-neutrino forces are from the outset relativistic.

This means: (1) there is a dissymmetry between electron-electron and neutrino-neutrino forces on account of the different rest masses entering into the energy denominator in both cases; (2) comparing a charged with a corresponding neutral interaction of the same strength, that is, using equation 3, it is readily seen that, for similar reasons, another dissymmetry exists, namely, between 'like particle' and 'unlike particle' forces. Therefore we may state that, even if equation 3 holds true, there is in the electron-neutrino case no equivalent of the charge independence of the interaction between nucleons as brought about by a symmetrical theory of nuclear forces.

The situation may thus be summarized as follows: the short life-time of neutral mesons can be explained by Sakata and Tanikawa's process, which means that there is an essential dissymmetry in effects responsible for the decay of charged and neutral mesons respectively. Against this picture objections of principle can be raised (divergences). Alternatively, one can use equation 1, which exhibits symmetry with charged meson decay, and replace equation 3 by 2, which on account of the fundamental dissymmetries of the electron-neutrino interaction is not unplausible. The objections raised against the former treatment, moreover, do not apply here; thus it would seem not inappropriate to suggest this possibility, although it must be admitted that the present discussion, because an *un*observability is at stake, is somewhat academic.

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[1] Sakata, S., and Tanikawa, Y., *Phys. Rev.*, 57, 548 (1940).

Mechanism of Brittle Rupture

FOLLOWING the suggestion of one of us (J. B. M.)[1,2] that the decay of strength of glass with time could be explained on the assumption that the glass consists of an elastic matrix containing small pockets of quasi-viscous material, E. Orowan[3] gave an explanation of the process which was compatible with the presence of 'Griffith cracks' in glass.

Since the extension of a crack is an irreversible phenomenon, the process outlined by Dr. Orowan involves a permanent reduction in strength of glass which has been subjected to a stress exceeding the 'wet strength'. To check this experimentally, we have loaded glass rods for 1,000 minutes with a stress sufficient to break about 20 per cent of the rods, and have then compared the strength of the survivors with a group from the same family which had not been subjected to prolonged loading. In order to make the comparison a true one, we discounted the lowest 20 per cent from the group which had not been pre-stressed, to compensate for the 20 per cent which broke in the pre-stressed group during the loading period.

The strength was determined on a standard testing machine which applied a stress increasing at the rate of 0·25 kgm./mm.^{2}/sec., and which was fitted with an automatic cut-off at the instant of breakage. Special precautions were taken to ensure that the same part of the rods subjected to maximum stress during the prolonged loading also received the maximum stress during the standard strength test (the test being of the bending type). The rods had been carefully selected for quality, and were annealed before use; they had also been wrapped at the point of manufacture to avoid scratches. The following table shows the results of the tests.

		Mean breaking stress	Standa deviati
(*a*)	90 rods stressed to 4½ kgm./mm.^{2} for 1,000 minutes; tested four days after unloading	10·6 kgm./mm.^{2}	1 86
(*b*)	90 rods from same group as (*a*) not subjected to pre-stressing ..	10 4 „ „	1·90
(*c*)	80 rods stressed to 4½ kgm /mm.^{2} for 1,000 minutes; tested one minute after unloading . ..	10·2 „ „	1·75
(*d*)	80 rods from same group as (*c*), not subjected to pre-stressing ..	10·0 „ „	1·82

A difference of 7 per cent in the strength woul be statistically significant, and we are therefo entitled to state that there was no permanent reduction in strength exceeding this amount when glas rods were subjected to a stress of 4½ kgm./mm. for 1,000 minutes. Since the strength of rods mad of this glass falls by as much as 30 per cent when th loading time is increased from 1 minute to 1,00 minutes, it seems that we cannot account fo this by the increase in length of 'Griffith cracks'. S far we have not found it possible to reconcile wit experimental results any theory about the strengt of glass which requires the decay of strength to b due to extension of cracks. This is one of the reason which led to the suggestion that the decay of strengt is connected with the relaxation of a quasi-viscou component of glass, and since this demands that th strength shall be recovered after unloading, due t the recovery of the quasi-viscous component, ou experiment supports the theory.

It should also be noted that the theory demand that all glasses shall exhibit a delayed elastic effect since the quasi-viscous component must cause delay in the distortion of glass under load; furthermore, since both the delayed elastic effect and th decay of strength are supposed to be due to the relaxation of the quasi-viscous component, ther should be a relationship between the rates at whic the two effects occur. Experiments designed t test this deduction are now under way; the chie difficulty being that the delayed elastic portion o the deformation of many glasses under load at roon temperature is very small, being 1 per cent or les of the total deformation. Preliminary experiment have shown that the strain, σ, may be represente over fairly wide ranges of time by the equation, $\sigma = P(k_1 + k_2 \log t)$, where P is the applied stress, the time elapsed since loading, and k_1 and k_2 ar constants. (A similar equation representing the appearance of strain in glass fibres under load wa found to represent experimental results by P. Phillips[4].) It is of interest to note that, on the assumption that the proportion of full-stress concentration achieved at time t is the same as the proportion of full relaxation of a quasi-viscous component at that time, the equation quoted above leads to the expression $P_B(k + k' \log t) = k''$ relating breaking stress P_B with time. It has already been noted by R. N. Haward[5] and F. W. Preston[6] that $1/P_B$ *v.* $\log t$ is substantially a straight line for the two or three glasses already examined.

This relationship, $P_B(k + k' \log t) = k''$, yields the same values of P_B as the earlier one proposed by one of us[1], namely, $P_B - a = b/t^x$, when x is a small number. Over the practical ranges of time available for the experimental work, the two equations lead to almost identical results; but the fact of greatest interest to us at present is the relationship of these results with the delayed elastic effect—a prediction which was made from the suggestion that glass contains a small proportion of quasi-viscous component. This relationship cannot be given accurately until experiments on which we are now engaged are mpleted, but we think the general agreement noted ove to be of sufficient interest to report at the sent time.

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urgatroyd, J. B., *Nature*, 154, 51 (1944).
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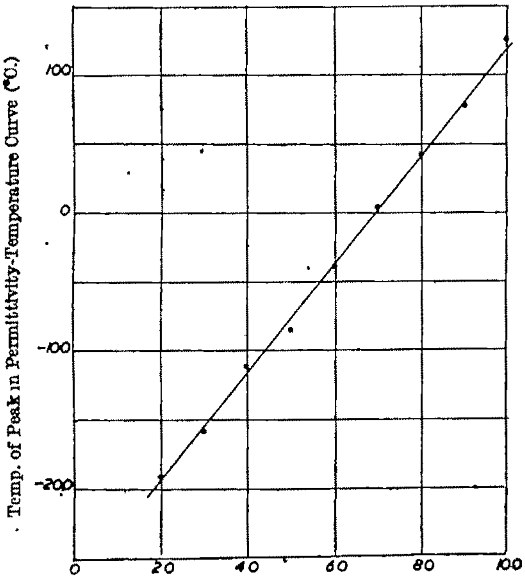
igh Permittivity Crystalline Aggregates

IN view of the recent communication by Dr. B. ul[1], it is desirable to mention that extensive studies the unusual dielectric properties of a range of tanates of perovskite structure and of related subances have been made by a number of research oups both in Great Britain and in the United States ring recent years. We ourselves have been coerating with the British Pottery Research Associaon and Dr. W. H. Taylor, now of the Department Crystallography, Cavendish Laboratory.



The peaked permittivity – temperature behaviour, own for barium titanate by Dr. Wul, is characteris of a range of materials. For the solid solution ries $BaTiO_3$—$SrTiO_3$, the temperature at which e peak occurs is a simple function of the percentage mposition, as shown in the accompanying graph. eak permittivity values of the order of 10,000 have een obtained. The general shape and height of the eak are similar for all the compositions referred to, that Dr. Wul's statement "the dielectric constants the perovskites investigated were found to grow ith the increase of size of the alkaline earth ion" somewhat misleading.

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Wul, B., *Nature*, 156, 480 (1945).

Autoxidation of Linoleic Acid

IN connexion with work on the purification of soybean lipoxidase[1], an investigation was undertaken to identify the primary products formed from linoleic acid when it was oxidized by molecular oxygen with this enzyme or with inorganic catalysts.

In the latter case, methyl linoleate was shaken in oxygen at 37° in diffuse daylight until at most 0·30 mol. oxygen had been absorbed per mol. ester. All absorbed oxygen was present as peroxidic groups (Lea). A strong absorption at 232 mμ appeared during the autoxidation, and increased parallel with the oxygen uptake. The oxidized ester was then directly subjected to chromatographic separation on alumina. Besides unchanged methyl linoleate, two types of peroxides could be separated: (*a*) a more easily eluted mixture of peroxides with a strong ultraviolet absorption ($\varepsilon 232 > 10{,}000$), which on hydrogenation yielded a mixture of primarily monohydroxystearic acids; (*b*) a mixture of peroxides with a negligible absorption above 220 mμ, which on hydrogenation yielded a mixture of hydroxystearic acids, that could be split by lead tetracetate. The consumption of the reagent corresponded to a content of 60–70 per cent dihydroxystearic acid (*c*). A ketonic non-peroxidic entity absorbing at 277 mμ was formed during the chromatographic separation and was eluted with the first fractions of (*a*). Both (*a*) and (*b*) had peroxide values (Lea) of 70–100 per cent of that required for a monoperoxide of methyl linoleate.

The amount of (*a*) plus (*c*) was roughly four times that of (*b*). Approximately the same proportions of mono- and di-hydroxystearic acids were formed when the autoxidized ester was hydrogenated directly and the products separated by chromatographic adsorption.

From the hydrogenated products of (*a*), two pure monohydroxystearic acids were isolated. These two acids, provisionally called M_1 and M_2, constitute the main part of this fraction. M_1 (m.p. 75–76°; methyl ester, m.p. 50–52°) and M_2 (m.p. 75–77°; methyl ester, m.p. 51–52°) give large depressions of the melting point when mixed. In order to identify them we are preparing a number of isomeric monohydroxystearic acids and have so far prepared the 10- and 12-isomers, which are not identical with M_1 and M_2.

We have now obtained melting-point samples of the acids (kindly supplied by Dr. Roger Adams, University of Illinois, Urbana, Ill.) prepared by Tomecko and Adams[2]. M_1 has been identified with 13-hydroxystearic acid and M_2 with the 9-hydroxy acid by the mixed melting point of acid and esters. Both give large depressions with the other isomers available.

These results seem to indicate that the oxygen was primarily formed a hydroperoxide group at C_{11} between the double bonds of methyl linoleate (I) in accordance with the theories and results of Rieche, Hock[3], Criegee[4], Farmer[5] and others. The 11-hydroperoxide (II) rapidly rearranged to a mixture of $\Delta^{10:11;\ 12:13}$ 9-hydroperoxido (III) and $\Delta^{9:10;\ 11:12}$ 13-hydroperoxido octadecadienoic acid methyl ester.

I. $CH_3(CH_2)_4CH{:}CH\ CH_2.CH{:}CH.(CH_2)_7COOCH_3$
(13) (12) (11) (10) (9)
II. $.CH{:}CH\ CH(OOH).CH{:}CH.$
III. $.CH{:}CH.CH{:}CH\ CH(OOH).$
IV. $.CH(OOH).CH{:}CH.CH{:}CH.$
V. $.CO.CH{:}CH.CH{:}CH.$

The conjugated double bonds of these rearranged peroxides would explain the appearance of the absorption at 232 mμ and they would on hydrogenation yield 9- and 13-hydroxystearic acid.

The ketonic entity absorbing at 277 mμ that was formed during the chromatographic separation was probably the doubly unsaturated ketone formed from any of these peroxides by dehydration on the alumina, for example, V.

The peroxides in fraction c yielded on hydrogenation high proportion of α-glycolic hydroxy-acids. This might either indicate that the oxygen was to a minor extent directly added to a double bond (cf. Atherton and Hilditch[6]) or that secondary oxidation of the conjugated double bonds had occurred. The point cannot be decided until further work has been carried out on this fraction.

Furthermore, the potassium salt of linoleic acid has been oxidized in aqueous solution with soybean lipoxidase at 37°. Under these conditions one mole of oxygen can be absorbed per mole of acid in a few minutes. From the hydrogenated reaction product 9- and 13-hydroxystearic acids have also been isolated.

The enzymatic oxidation of linoleic acid with lipoxidase thus seems to follow the same course as ordinary autoxidation.

A full report is being published in *Arkiv för Kemi*, Stockholm.

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July 25.

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[1] Theorell, Bergström and Akeson, *Arkiv Kemi, Min. Geol.*, 19 A, No. 6 (1944).

[2] Tomecko and Adams, *J. Amer. Chem. Soc.*, 49, 522 (1927).

[3] Hock, *et al.*, *Naturwiss.*, 24, 159 (1936); *Ber. deut. chem. Ges.*, 66, 61 (1933); 71, 1430 (1938); 72, 1562 (1939); 76, 169, 1130 (1943).

[4] Criegee, *Ann. Chem.*, 522, 75 (1936); *Ber. deut. chem. Ges.*, 72, 1799 (1939).

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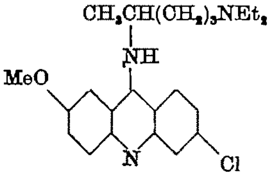
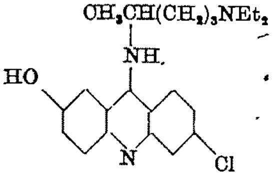
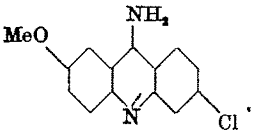
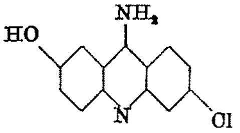
Primary Degradation Products of Mepacrine in Human Urines

IN a previous note[1] it has been reported that 2-chloro-5-amino-7-hydroxyacridine is to be found in the urines of mepacrine-taking subjects. We have now subjected such urines to a separation technique based on that applied by Scudi and Jellinek[2] to the urines of dogs.

After chromatographic purification on alumina and elution with water or dilute acid, we have obtained solutions in which we have been able to demonstrate the presence of the compounds 2-chloro-5-amino-7-methoxyacridine (II) and 2-chloro-5-(δ-diethylamino-α-methylbutylamino)-7-hydroxyacridine (I), as well as 2-chloro-5-amino-7-hydroxyacridine (III). These compounds have been identified by measurements of their half-wave (reduction) potentials, in buffered solutions, by means of the Cambridge polarograph and comparison with the potentials of authentic specimens determined under similar conditions.

Fuller details of the work will be published elsewhere; in the meantime, we select data sufficient to establish the correctness of our conclusions. It will be noticed that the diagnostic value of the half-wave potential is considerably enhanced by the fact that acridines show two stages in polarographic duction, each of which, at a particular pH, is ch acteristic of the particular derivative.

Below we give, as E_1 and E_2, the half-wave pote tials of the respective acridine derivatives, the fi being mepacrine itself. E_1^A, E_2^A, $E_1^{B_1}$, etc., refer the potentials of the urinary products obtained frc the fractions A, B_1, B_2 and C of the Scudi and Jellin procedure (*loc. cit.*).

Compound	Buffer pH		Half-wave potential
 Mepacrine	pH 7·3	E_1	−1·12
		E_2	−1·41
		E_1^A	−1·12
		E_2^A	−1·41
 I	pH 7·3	E_1	−1·02
		E_2	−1·27
		$E_1^{B_1}$	−1·02
		$E_2^{B_1}$	−1·28
 II	pH 7·3	E_1	−1·20
		E_2	−1·43
		$E_1^{B_2}$	−1·20
		$E_2^{B_2}$	−1·43
 III	pH 9	E_1	−1·20
		E_2	p
		E_1^C	−1·20
		E_2^C	p

(p = prior discharge of buffer ions)

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[1] *Nature*, 154, 461 (1944).

[2] *J. Biol. Chem.*, 152, 27 (1944).

Instability of Dienœstrol and Stilbœstro Solutions

WHILE investigating the metabolism of syntheti œstrogens, we encountered anomalous results durin assays of œstrogenic potency which led us to believ that dienœstrol was unstable in solution. Serie assays carried out on standard solutions of dien œstrol and stilbœstrol have shown the suppositio to be correct.

Solutions of dienœstrol (1 µgm. per ml.) were pre- red in distilled water, $N/500$ hydrochloric acid, d $N/500$ caustic soda, and assayed at intervals cording to the standard method of this Institute vice-daily injections for three days into groups of -20 spayed rats and recording the proportion that go o œstrus or full pro-œstrus within two days of the t injection). The results in Table 1 show that the id and alkaline solutions deteriorated more rapidly an the neutral solution. Polymerization is a possible planation of the change, and this suggestion is pported (though not proved) by the facts that the s of activity in a neutral solution of dienœstrol greatly hastened by the addition of a trace of drogen peroxide but is inhibited by the addition hydroquinone (1 µgm. per ml.). The doses used the assays have been high—3 µgm., representing ree to six times the ED 50 for dienœstrol.

BLE 1. RESPONSES OF SPAYED RATS TO DIENŒSTROL SOLUTIONS.

Solution	Neutral		Acid		Alk.		+ Hydroquin.	+ H_2O_2
ose* (µgm.)	1·0	3·0	1·0	3·0	1·0	3·0	0·7	3·0
ge of solution (weeks)	%	%	%	%	%	%	%	%
1	40	—	10	–	0	–	70	0
2	—	100	—	0	–	0	—	–
3	—	—	—	0†	–	0†	40	–
5	0	100	—	–	–	–	—	–

* Dose calculated on dienœstrol originally present.
Dose of 6·0 µgm.

BLE 2. RESPONSES OF SPAYED RATS TO STILBŒSTROL SOLUTIONS.

Solution	Neutral		+ Hydroquin.		+ H_2O_2
Dose* (µgm.)	0·3	0·4	0·3	0·4	0·3
Age of solution (weeks)	%	%	%	%	%
1	10	—	40	—	100
3	—	0	—	80	0

* Dose calculated on stilbœstrol originally present.

Similar tendencies for the biological activity of lbœstrol to deteriorate have been demonstrated. ere again, hydrogen peroxide hastens the loss of tivity and hydroquinone has a stabilizing effect able 2).

The numbers of animals used have been too small allow an accurate estimation of the rate of decom- sition of either substance to be made. Experiments e in progress to obtain more quantitative data ich will be published elsewhere.

Similar results have been arrived at independently F. L. Warren and F. Goulden[1], using the Dinge- anse[2] method of chemical estimation of the com- unds.

These facts mean that the results of assays made dienœstrol or stilbœstrol solutions that are not shly prepared will be low, as will be estimates of e excretion of these compounds where their in- bility in biological liquids has not been taken into count. Although it is not expected that solutions natural œstrogens or of hexœstrol will show similar anges, their stability is also being investigated.

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[1] arren, F. L., and Goulden, F., [*Proc. Biochem. Soc.* (Sept. 28, 1945)].

[2] ingemanse, E., *Acta brev. neerl.*, 9, 118 (1939).

Parathyroidectomy and Lactation in the Rat

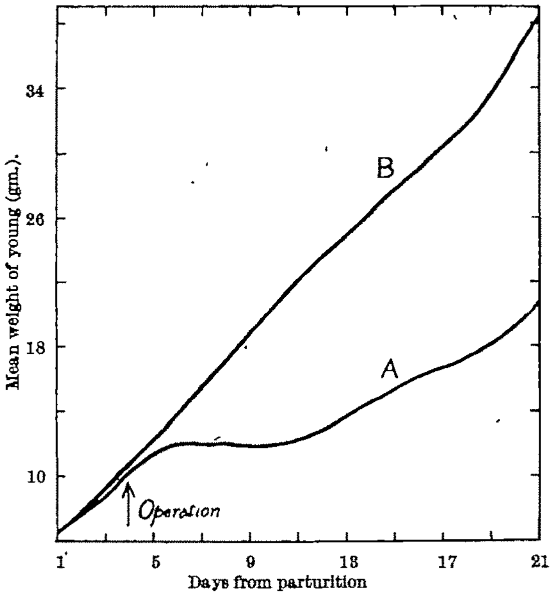
So far as we are aware, no accurate study of the effect of parathyroidectomy on lactation has yet been made, though Chandler[1] noted that the young of parathyroidectomized rats were often smaller than normal, suggesting that lactation was impaired. In the rat, thyroidectomy entails removal of the two parathyroids, one of which is embedded in each lobe of the thyroid; but the marked decline in lactation which some workers[2,3,4,5] have reported following thyroidectomy in the rat has usually been attributed to loss of the thyroid, since symptoms of tetany are generally not seen in rats thyroidectomized during lactation[3,4,5]. However, the results of Folley, Scott Watson and Amoroso[5], who found that lactation could be partially maintained in thyroidectomized rats by parathyroid extract, suggested that the impairment of lactation following thyroidectomy may be, at any rate partially, due to loss of the parathyroids. If this were true it would seem possible that those workers[6,7] who found that thyroidectomy had no effect on lactation used a strain of rat in which accessory parathyroids are the rule rather than the exception as is generally believed[8].

We have recently had an opportunity of investigating directly the effect of parathyroidectomy on lactation in the rat, using rats from the same colony and similar experimental methods as in previous lactational studies[9]. Six normally lactating rats were parathyroidectomized on the fourth day of lactation by a technique slightly modified from that of Richter and Birmingham[10]; three control rats were subjected to a sham operation. The growth-rates of the litters of all except one of the parathyroidectomized rats underwent a marked decrease soon after the operation (see graph and table). In constructing the growth-curve reproduced, the data for the litter of the exceptional rat, which continued to grow at a normal rate (see table), were omitted.

Treatment	No. of rats	No. of young on 4th day of lactation		Mean wt. of young (gm.) on day of lactation			Percentage of young alive on day of lactation		
		♂	♀	4	15	21	4	15	21
Sham operation	3	12	12	10·9	27·8	38·4	100	100	100
Parathyroidectomy	5	28	10	10·2	15·4	20·9	100	87	84
Parathyroidectomy (rat with presumed accessory parathyroids)	1	4	4	11·5	29·0	44·0	100	100	100
Thyroidectomy*	6	19	25	10·0	13·4	19·0	100	89	66

* Data from Folley[2].

Owing to the fact that these were surplus rats from another experiment, it so happened that one of the control and two of the parathyroidectomized rats received a high-protein diet, which we have found to exert a slightly deleterious effect on lactation, while the rest received the normal stock diet[9]. Analysis of the results for individual rats clearly showed, however, that this factor had no effect on the conclusion to be drawn from this experiment, namely, that parathyroidectomy caused a marked decline in, but not complete cessation of, lactation. This conclusion is, of course, as in all experiments of this nature, subject to the proviso that the only criterion at present available for measuring the milk yield of laboratory rodents—the growth-rates of litters—is a valid one.



CURVE *A* · GROWTH-CURVE OF THE LITTERS OF FIVE PARATHYROIDECTOMIZED RATS, CURVE *B*: GROWTH-CURVE OF THE LITTERS OF THREE SHAM-OPERATED CONTROLS.

At the end of the experiment the rats were killed and the thyroids sectioned serially and examined for parathyroid tissue. None was found in any parathyroidectomized rat, including the anomalous animal. It seems reasonable to assume that this rat alone of the group possessed sufficient accessory parathyroid tissue to support normal lactation. In this connexion it may be recalled that accessory parathyroids were previously found in 17·2 per cent (approximately 1 in 6) of a group of rats from the same colony[5]. In accordance with previous findings with thyroidectomized rats, no symptoms of tetany were seen in these rats after parathyroidectomy.

There is some evidence (see table) that the effects on lactation of parathyroidectomy are scarcely less severe than those of thyro-parathyroidectomy[2]; but it would not be safe to conclude that the loss of the thyroid alone would have no influence on milk-yield, since more complete inhibition of lactation following thyro-parathyroidectomy was noted in a subsequent experiment[5], in which, however, the growth of the young prior to the operation was slightly sub-optimal. It is planned to investigate this aspect of the subject further.

We are indebted to the Agricultural Research Council for a research grant to one of us (A. T. C.), and to Dr. S. K. Kon for the facilities of his rat colony.

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Aug. 7.

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[3] Preheim, D. V., *Endocrin*, **27**, 494 (1940).

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[6] Nelson, W. O., and Tobin, C. E., *Endocrin.*, **21**, 670 (1937).

[7] Nelson, W. O., *Amer. J. Physiol.*, **126**, P592 (1939).

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[9] Cowie, A. T., and Folley, S. J., *Yale J. Biol. Med.*, **17**, 67 (1944).

[10] Richter, C. P., and Birmingham, J. R., *Endocrin.*, **29**, 655 (1941).

Nature of the Gram-positive Complex In Micro-organisms

IN a previous communication[1] it was suggest
that the Gram-positive material in micro-organis
is a high-molecular complex formed by the combin
tion of a reduced basic protein in the cell cyt
skeleton with magnesium ribonucleate. We ha
now succeeded in extracting from various organis
the Gram-positive complex which has the essent
characteristics of a magnesium-containing nucle
protein, the protein constituent of which appears
be of a novel type and to differ particularly fro
known histones and protamines. All attempts, usi
methods described in the literature[2,4], to extra
basic proteins of the histone or protamine type fro
the highly resistant cell cytoskeletons failed to yie
more than traces of compounds having a high-bas
amino-acid content.

The method of obtaining the complex from Gra
positives involved a relatively short autolysis of t
cells at pH 8 and 37°, followed by adjustment of t
centrifuged supernatant to pH 5, at which point
precipitate was thrown down. This consisted
nucleoprotein which was purified by reprecipitati
methods and when fixed on a slide stained intense
Gram-positive. The dye-retaining nucleoprotei
from yeast and *Cl. welchii* have been examined
some detail. The material from yeast readily di
solved in aqueous solution at pH 7 had N, 14·
purine N, 2·9; P, 2·6; ribonucleic acid, *c.* 25 p
cent, and contained —SH groupings. On heating
neutral aqueous solution of the nucleoprotein at 6
for a short time, the protein constituent came dow
in denatured form leaving the nucleic acid in sol
tion, a phenomenon which resembled the behavio
of Cohen and Stanley's[3] tobacco mosaic virus rib
nucleoprotein. By a relatively simple procedure
has been possible to dissociate the protein from i
combination with nucleic acid and to obtain bo
constituents in a reasonable degree of purity. Tl
nucleic acid was entirely of the ribo-type. The pr
tein, isolated in the form of its soluble hydrochlorid
was free from phosphorus and pentose, and ha
N, 14·3; arginine, 5·5 per cent; it was readily d
natured on being dried or heated. Neither the pr
tein nor the nucleic acid alone could be stained l
Gram's method; but on re-forming the complex
pH 5, preferably in the presence of magnesium io
and formaldehyde, it again stained strongly Gra
positive. The Gram-positive nucleoprotein from
welchii closely resembled the yeast product in gener
properties. Thus, it was soluble in water at pH 7, h
N, 14·9; purine N, 2·9; P, 2·5 and contained Mg a
—SH groups. It was, however, more difficult to se
arate into its protein and nucleic acid, while tl
latter had the important difference in that it contain
the deoxy- (3·5 per cent) as well as the ribo-ty
(27 per cent). The dissociated protein constituent ha
N, 14·3 per cent, and contained —S—S— links.

In order to examine the dye-retaining properti
of protein nucleates stained by Gram's method,
number of 'artificial' complexes were made by addi
basic proteins such as protamine salts to magnesiu
nucleates at pH 6–7, whereby precipitates containi
both protein and nucleic acid were thrown dow
Typical nucleates made were protamine ribonucleat
clupeine ribonucleate, histone ribonucleate, histo
deoxyribonucleate, etc. When stained, certain
these, particularly the histone deoxyribonucleate, r
tained in some measure the basic dye; but in gene

results were unsatisfactory, and the stained parations were not comparable with the intensely ined bacterial nucleoproteins. It was clear that the Gram-positive complex the linkage of the pro- n with the ribonucleic acid is not of the simple ctrovalent type, and the mechanism of the reten- n of the dye is more fundamental than its mere nbination with a basophilic salt-like molecule; phydryl groups and magnesium ions do appear to y an important but as yet undetermined part.

So far we have not been able, by using an analogous tolytic procedure, to obtain nucleoproteins from am-negatives. By chemical extraction methods, wever, using bile salt derivatives, saline, etc., we ve obtained nucleic acids of both ribo- and de- yribo-types from certain Gram-negatives. Some ctions contained both proteins and nucleic acids, d when solutions of these were adjusted to *p*H 5, ere separated protein nucleates which were able retain the Gram stain in a manner comparable ith that described above for the 'artificial' protein cleates. Thus it appears that this amount of dye- taining character is a non-specific property of such lts which, as isolated from Gram-negatives, we gard as artefacts. It was also of interest to note that, the Gram-negatives so far examined, the ratio of oxyribonucleic to ribonucleic acid is consider- ly higher than in Gram-positives. Thus we con- der that there are fundamental differences between e basic proteins of Gram-positives and Gram- gatives, and between their mode of combination ith nucleic acids; so that an understanding of these desirable in order to give an insight into the mech- nism of the selective attack of some antibiotics.

Mirsky[4] has pointed out that in deoxynucleo- stones the nucleic acid content is about 40 per cent, hereas in ribonucleoproteins it is of the order of 0 per cent. It will be noted that in our Gram- sitive ribonucleoproteins the amount of ribo- ucleic acid (25 per cent) falls midway between the vo, and it is possible that the protein constituent presents one type of cytoplasmic protein of which it little is yet known. Moreover, this protein pears to differ from that of the histone or protamine pe which was obtained from pneumococcal nucleo- otein[5].

H. HENRY.
M. STACEY.
ETHEL G. TEECE.
(Beit Memorial Research Fellow.)

Department of Chemistry,
University of Birmingham.
July 25.

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Late Flowering of Horse-Chestnut

DR. JULIAN HUXLEY's letter[1] describing the late owering of horse-chestnut in Paris this autumn rought back to me a vivid memory of autumn 1912. turned up my youthful diary and found this entry: Paris, 3rd September, 1912. The trees are in a queer tate here; the old leaves are dead and falling as in utumn and at the same time new shoots and flowers are borne on the same trees, particularly on the horse-chestnuts in the Champs Elysées." There are few records of weather in the diary but an earlier entry of the same day reads: "We went through the Luxembourg Gardens where the lawns were being watered! (the first time I have seen grass watered this year!)". And on the day before, it had seemed worth while to enter: "It rained a little".

E. M. BLACKWELL.

Royal Holloway College,
Englefield Green,
Surrey.
Nov. 17.

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[1] *Nature*, 156, 574 (1945).

THE publication of the note by Dr. Julian Huxley prompts me to record some observations of a similar phenomenon in 1944.

At the beginning of October flowering was noticed on a tree of *Aesculus hippocastanum* at Twickenham, Middlesex, in circumstances similar to those described by Dr. Huxley. This tree had been damaged severely by the frosts of May 3–8. The opportunity was taken of comparing its behaviour with that of two trees of the same species in Sunbury-on-Thames which were defoliated almost completely by blast from a flying-bomb in early August. They were in flower for the first three weeks of October until the blossoms were killed by frost. Small fruits were formed but did not mature. These dates are later than those commented upon by Dr. Huxley.

In 1945, the three trees mentioned produced fewer leaves than usual and very few inflorescences. Most of the buds containing inflorescences must have been used in the autumn flowering.

It is interesting that, although the defoliation of the frost-damaged tree was in May and the bomb-damaged trees in August, all were in flower together in October. Similarly the trees observed by Dr. Huxley were damaged in spring but did not flower again until the autumn, the buds opening at the usual time for leaf-fall.

The mild autumn weather experienced in 1944 may be connected with the second flowering, as this was seen, also, at Sunbury-on-Thames in a species of *Aesculus carnea* Hayne which was not noticed to be damaged in May. It would appear that it is the already defoliated condition of the trees of *Ae. hippocastanum* at the usual time for the commencement of leaf-fall which stimulates the opening of the buds at that time, the production of new leaves and inflorescences in the buds proceeding at the same rate during the summer whether mature leaves are present or not. A comparison between the autumn condition of such a tree and that of a normal tree in the similar temperature and light conditions of spring is tempting.

In view of the fact that some of the species of *Aesculus* flower normally as late as August it would be interesting to observe the behaviour of those trees of European, Asiatic and American ancestry which are collected close together, in virtually the same environment, at the Royal Botanic Gardens, Kew, in any season when second flowering takes place.

H. G. BAKER.

Botany Department,
The University,
Leeds.
Nov. 16.

THE INDIAN STATISTICAL INSTITUTE

THE continued activity and growth during the war period of the Indian Statistical Institute is a striking example of the benefits which may flow from the stimulus of war conditions, when individual initiative is unhampered in putting itself at the service of Government and to meet the needs and deficiencies of existing official organization. Perhaps nowhere than in India have the prevailing conditions been more propitious, or the need greater, for the active use of agencies run at private risk for public purposes.

The Institute, as it has now developed, has many facets: on the educational side equally as a training ground for computors and routine statisticians, and as a centre of postgraduate research in the most far-reaching branches of the mathematical theory of statistics and experimental design; as a professional institute and learned society bringing together all schools of thought in Indian statistics; as an agency employed by departments of Government and advisory bodies, in the essential work of collecting, scrutinizing and digesting the facts upon which administrative decisions must depend. The achievement of co-operation among the many able men needed to guide these various activities has been the work of an applied mathematician, Prof. P. C. Mahalanobis, formerly professor of physics, acting as honorary secretary to the Institute. He was this year elected fellow of the Royal Society.

There can be no doubt that accurate knowledge by the Government of Bengal of the amount of rice available in the Province would have obviated the food crisis of 1943, in which approximately one million lives were lost, by forestalling panic and cutting the ground from under the food speculators. The story is told in the report for 1943–44:

"The most notable progress in the year under review was achieved in the sample survey of crops. It would be remembered that work was started on a small scale with a total expenditure of about Rs. 7,000 on an exploratory survey of the jute crop in Bengal in 1937. This was the beginning of a five-year scheme for the improvement of jute statistics which was financed jointly by the Indian Central Jute Committee and the Government of Bengal. The sampling technique, developed in the course of a gradually expanding series of surveys culminating in the full scale provincial work of 1941, which demonstrated beyond dispute the possibility of securing by this method a final estimate of jute acreage with a margin of error of only two or three per cent at a cost of one-fifteenth or one-twentieth of that of a complete enumeration. A general account of the five-year scheme with discussion of theoretical foundations was given in a memoir prepared by the Hon. Secretary in 1942 which is being published in the *Philosophical Transactions* of the Royal Society of London.

"The Hon. Secretary had been pressing from the very beginning of the five-year scheme in 1937 for the extension of the method to cover paddy and other important crops in Bengal. Each year from 1938 to 1942 he repeated his efforts but without success. In 1942 the Indian Central Jute Committee had expressed their complete satisfaction with the method of the sample survey and had recommended its continuance by Government in future. The Government of Bengal however decided at first to discontinue the work but subsequently revoked their decision a asked the Hon. Secretary at the end of March 19 to proceed with the Jute survey. By this time good portion of Burma had been occupied by t Japanese, and the supply of rice from that count had been cut off. Apprehending a serious deterio tion in the food situation (not because of the physi volume of the import which was small but becau of the possible effect on prices) the Hon. Secreta submitted a definite scheme to the Government India at the end of March 1942 for extending t sample survey to cover the paddy crop in Beng In the course of the next few months he also d cussed the question with a large number of offici in Bengal but all his efforts failed completely. In t absence of reliable statistics both the provincial a the Central Governments were left entirely in t dark regarding the supply position of rice at the e of 1942. This made it impossible for Government pursue a consistent food policy on any objecti basis. The weakness of the statistical position w thus an important factor in bringing about t deplorable food crisis in Bengal in 1943."

It was not, therefore, until after the famine th the Institute was enabled to show what its organiz tion could do with the immense problem of sampli the 70,000 square miles of agricultural Beng Adequate accuracy in areas under crops is much mo difficult to attain than is yield for unit areas. Son 59,000 grids each of 2·25 acres, chosen on a syste of stratified random sampling, were needed f Bengal, the whole being divided into zone cells sixty-four square miles and sub-cells of one squa mile, approximately the area occupied by a sing village. A feature of great importance for India conditions, and worthy of study elsewhere, is t duplication of the system in interpenetrating ne works, so that entirely independent pairs of estimat are available for each area. This not only facilitate the administrative checking of gross negligence, misunderstood instructions, but also enables the pr cision of the final estimate to be assessed as it real is by including all causes, human as well as physica which contribute to inaccuracy in the result.

There is perhaps no other organization in whic practical and theoretical work are more thorough integrated. The combinatorial investigations of R. Bose and A. Bhattacharya and the studies of mult variate distributions of Mahalanobis and S. N. Ro supply not only the general plan but also ver detailed guidance to the two hundred or so worke of the field and computing staffs.

EXCAVATIONS AT HYRAX HILL, NAKURU, KENYA COLONY

ALTHOUGH uncertainties in detail may sti exist, the general structure of the prehistor story of Kenya as laid down by Dr. L. S. B. Leake is now accepted by most prehistorians. The variou climatic changes that have occurred and their co relations with the more important cultures found a also clear. Following on a major pluvial phase calle Gamblian and correlated with the Kenya upp palæolithic, there were two merely wet phas separated by a dryer period. These are know respectively as the Makalian and the Nakuru w phases. They are post-palæolithic in age, and th latter is not of great antiquity.

Mary D. Leakey, in a paper entitled "Report on
) Excavations at Hyrax Hill, Nakuru, Kenya
lony, 1937–1938" (*Trans. Roy. Soc. S. Africa*, 30,
. 4), describes excavations made at sites on an
inence which was under water during the period
vered by the last major pluvial (Gamblian), and
ng the sides of which occur beach-levels of the
bsequent wet phases. Correlation of the archæ-
gical and geological records is therefore simple. A
mber of sites, including some stone-walled en-
sures and a low mound, were investigated, as well
a group of pit dwellings. There were found : (1) a
olithic occupation site and cemetery, (2) a Gumban
eolithic) pit-dwelling village, and (3) a later, prob-
ly not very ancient, level connected with the
ne-walled enclosures and associated burial pits
d with an industry which shows the influence of
ab traders.

The neolithic occupation site lies on the 335-ft.
ach (Makalian) and is therefore subsequent to its
rmation ; the Gumban pit-dwelling is somewhat
unger in age and contains an industry (Gumban *B*)
ich is well known elsewhere and has been assigned
the maximum period of the later (Nakuru) wet
ase. From the earlier neolithic levels there were
ought to light no less than eighteen skeletons—a
mber female—in contracted burials. These are
scribed in detail by Dr. Leakey.

The associated industry clearly shows its upper
læolithic origin, for it must be remembered that in
ast Africa there were no devastating climatic
anges of the magnitude of those which obtained in
urope ; cultures were not swept away but ripened
d went to seed ; the past continued to influence
e growth of the present much more than was the
se in Europe. Thus in the levels above mentioned,
ere were found a whole series of obsidian tools
early derived from normal Kenya upper palæolithic
pes. In the Gumban levels there were stone bowls
d pottery typical of the Gumban *B* neolithic.

The report contains 409 pages and is well illustrated.
l concerned in the post-palæolithic cultures of
enya will find it very interesting.

M. C. BURKITT.

AUTOMATIC CONTROL AND RECORDING IN CHEMICAL AND OTHER PROCESSES

THE Institution of Chemical Engineers, the
Institute of Physics and the Chemical Engineering
coup of the Society of Chemical Industry made
rangements more than a year and a half ago to
ld a joint conference in the autumn of 1944 on
cording and controlling in the chemical industries.
he incidence of flying bombs and of rockets, how-
er, made it inadvisable to gather together a large
umber of key technicians in London at that time,
d the conference was postponed indefinitely. This
s proved to be a fortunate circumstance ; for the
nference was held on October 19 of this year, when
e industries interested were not completely occupied
th war-time requirements, but were turning their
tention once again to the problems of ordinary
mmercial production. In consequence, the con-
rence has been held at a time when industry is not
erely aware of certain technical deficiencies but also
actually planning to do everything possible to overcome them. That the subject of the conference is of vital interest to the chemical industries, as indeed it is to all industries, was shown by the remarkable attendance, the lecture theatre at the Royal Institution being filled and almost over-filled. Apart from all other benefits which accrue from a conference of this kind, the personal contacts which are made between the makers and users of instruments provide ample justification for holding it, and it was a happy thought on the part of the organizers to arrange that the instrument firms should hold private exhibitions of their instruments on the following day.

In the opening address to the conference, given by the president of the Institute of Physics, Sir Frank Smith, two main points were made. The first was the interesting one that although in industry the scientific instrument is usually regarded as the handmaiden of industrial processes, experience shows that the emergence of a new type of instrument has often been responsible for the birth of a new industry. There is, for example, a great industry now in existence catering for the requirements of radar, and it is indisputable that radar, and the industry associated with it, could not and would not exist unless an instrument were available for measuring time intervals smaller than one millionth of a second. Some decades ago, Sir J. J. Thomson devised the first instrument capable of achieving such measurement. This was the cathode ray tube, which later became the cathode ray oscillograph. Without this instrument, and without also the wireless valve which was a development of an instrument (the one-way rectifier of Sir Ambrose Fleming), there could not have been any radar nor, in consequence, the great new industry which has developed around it. Equally spectacular examples could be cited; but it is probably true that nearly every big advance in industry has been the result of knowledge obtained in the first place by the use of a new instrument. There is, therefore, every incentive for industry to be instrument-conscious, apart from that arising from the benefits obtained by the use of instruments which is ancillary to industrial processes.

Britain has been warned, and is acutely aware, that the maintenance of its standard of living is dependent upon an increased export trade. The achievement of an increased export trade is dependent upon our ability to produce articles of exceptional and standard quality at competitive prices. The material articles which can be exported can be classed either as special products or as articles capable of being produced by mass-production methods. It is in the production of this latter category that a realization of the necessity of industrial instrumentation is essential. Only by the complete control of processes can an exceptional quality of product be made standard, and only by the avoidance of waste and the lowering of costs resulting from control can competitive prices be offered.

In some general observations on the use of recorders and controllers, the director of the British Scientific Instrument Research Association, Mr. A. J. Philpot, pointed out that the general industrial structure of Britain, with its preponderance of relatively small concerns, has been favourable to the creation and maintenance of a system based on the maximum use of individual craftsmanship and a large exploitation of personal knowledge and experience. Such a system served us well during a long period when industrial processes were relatively static; but the tempo of industrial progress has so increased, and the changes in industrial methods have become so rapid, that it is now essential that scientific investigation and observation should permeate the day-to-day carrying out of processes, and that in any industrial concern the appropriate knowledge must exist which will enable rapid and useful application to be made of any relevant advances in applied science. The use of instrument recorders and controllers is the prime means of ensuring that such observation and such accumulation of knowledge can be made.

There is little virtue in the mere installation of instruments unless steps are taken to see that the scientific method shall be applied to their use; the installation of instruments may eliminate a large amount of human error, but the whole purpose of the instruments may be defeated unless they are in the charge of technicians who understand the principles of their working and fully appreciate the existence of instrumental errors, which may vary from day to day and with changing physical conditions. Since recorders and controllers are based on physical principles, it would seem logical that the wide introduction of these instruments into industry should be accompanied by an extended use of physicists by industry. It is doubtful whether enough physicists exist to fulfil the requirements of industry, and, in any event, it may well be that the physicists required should have some special instruction and practical technical experience outside the normal university course in physics. While it is to be hoped that facilities for technical education of this type will be available in the future, every encouragement should be given to the younger technical personnel in industry to take advantage of the newly established courses for national certificates in applied physics.

The use of automatic control in the oil industry and in the pasteurization of milk were the subjects of papers by Mr. D. J. Pull and Mr. R. A. Hill, both of which were largely factual statements of the actual systems of automatic controls used in these two spheres. The diverse nature of control is well illustrated by the use of instruments for these two purposes. In the oil industry, when conditions have been achieved such that optimum results are obtained, the paramount need is for a system of control which will prevent any departure from these conditions. An absolute knowledge of, for example, the exact temperatures employed is of secondary importance compared with the rigid maintenance of these temperatures, as only thus can the production of a standard material be assured. In the pasteurization of milk, both an exact knowledge of the temperature and the maintenance of this temperature are essential, since the nutritive value of the milk, and the effectiveness of pasteurization achieved, are vitally dependent upon these factors. The chemical processes of the oil industry are extremely complicated and tend to become progressively more so; and it is evident that the development capacity of instrument manufacturers will be severely strained if instrument design is to keep pace with the control requirements of the industry.

It is perhaps unfortunate that the operation of a controlling mechanism appears to be simple and inexorably exact. The statement, however, that any physical phenomenon, the action of which can be measured, can be used to operate a controller which in turn limits the extent of action of the phenomenon, while generally true, gives no indication of the complications which are inherent in any controll
instrument. This point was well illustrated in t
papers of Prof. K. A. Hayes and Dr. G. D. Pri
which dealt with the mathematical analyses involv
in studying the characteristics of control systems a
of the stability of such systems. The growth in u
by industry of what is commonly called instrumen
tion has been exceedingly rapid, and it is not gen
ally recognized that there is involved in this inst
mentation a new branch of technical science, a
that knowledge of this technology has probab
lagged behind its application. Valuable work on t
subject has been carried out by the Servo Panel
the Ministry of Supply during the War, and althou
the attention of this Panel has naturally been direct
towards the problems of control in military usage,
for example, those inherent in the use of predicto
there is much ground common to these problems a
those connected with the control of industrial p
cesses. It would be a pity if knowledge of the valua
work carried out by the Servo Panel were not ma
available to those responsible for designing, install
and running control systems in industry. If indust
is to make full use of instrumental control, as
undoubtedly must do, then it would appear essent
that the establishment of courses in technical insti
tions in the technology of instrument control shou
be very seriously considered.

In reviewing the proceedings of the Conferen
perhaps the most vivid impression left on the mi
is the general agreement which exists that the tra
ing of physicists is not complete unless it results
students obtaining some knowledge of the m
general applications of physics in industry and,
particular, of the use of physical principles in t
control of industrial processes. It was urged at t
Conference, as indeed it has been urged elsewhe
that the equipment of the ordinary university phys
laboratory might well include examples of instrume
controls, and that in their practical courses studen
might examine the performance and limitations
these systems.

The Conference will have been well justified if
has emphasized the urgent necessity for a mo
general and thorough knowledge of applied physi
and if it has demonstrated that the use of instrume
controls in industry is based on a technical science
which knowledge at the moment is far too limited.

PLANT PATHOLOGISTS IN GREAT BRITAIN

A REPORT, "The Recruitment and Training
Plant Pathologists in Great Britain", which h
been prepared by the Plant Pests and Diseases Co
mittee and adopted by the Council of the Associati
of Applied Biologists, advocates certain improvemen
in the training of plant pathologists with a view to
higher and more uniform standard of proficiency
the time of recruitment into the service. The ter
'plant pathology' in this report is used in its wide
sense to include all disorders of plants, wheth
caused by insects, fungi, bacteria, viruses, etc.

The plant pathological services in Great Brita
have in the main been recruited from graduates
university biological (and to a less extent, chemic
departments who, in the majority of cases, ha
carried out postgraduate research, usually to t
stage of obtaining a Ph.D. degree. This mode

ining is considered to be too narrow, as it does not e proper emphasis to general aspects of crop sbandry, but tends to produce specialists in disease oblems who are insufficiently acquainted with the y-to-day problems of the practical cultivator. commendations for an improved course of training put forward in some detail, the most important which are as follows.

The basic requirement for an entrant into the ofession, whether as research worker or as advisory icer, is held to be the possession of a good university gree in pure science (namely, in botany, zoology or emistry); but this should be reinforced by a post-aduate course of study in plant pathology which ght suitably lead to a diploma in this subject. It suggested that two years would be ample for such course. The students, whether intending to become search workers or advisors, and whether entomogists or mycologists, would follow the same course a considerable period, so that all would possess e same general background, and only in the later rt would there be specialization in the various lines activity. In particular, the importance of condering research workers and advisory officers as uivalent groups and therefore of giving them sentially the same training is stressed. Throughout is course there would be instruction in crop husndry and in research methods, and facilities would provided for bringing all students in contact with e practical problems of plant cultivation.

The carrying out of this scheme would be most itably done in an institute of plant pathology, operly staffed for teaching and for the prosecution applied research; and with good contacts with the dustry on one hand, and with a university on the her. Failing the setting up of such an institute. rtain university departments should be strengthened long the lines indicated.

The need for refresher courses for advisors and search workers, for greater provision of technical sistance, and for the grant of scholarships to cover e period of two years postgraduate training is also dicated.

Copies of the report can be obtained from the resident of the Association of Applied Biologists, r. C. B. Williams, Rothamsted Experimental tation, Harpenden, Herts.

HOSPITAL DIET

N 1943, King Edward's Hospital Fund for London published its first Memorandum on Hospital Diet *Vature*, **155**, 433; 1945). Since then there has been uch constructive criticism. There has been so uch demand for the Fund's first memorandum that e Committee on Hospital Diet which it appointed, e chairman of which is Sir Jack Drummond, has ow issued a second memorandum (obtainable from . Barber and Sons, Ltd., 23 Furnival Street, E.C.4, d.). Everyone who has to cater for groups of people hould read it. The housewife, also, will learn much om it.

In many hospitals, says this second memorandum, e importance of good catering is now recognized; ut in others it is not. The catering department a hospital should be regarded as one of the ospital's main departments. It should be a separte unit, administered by a catering officer, who ould preferably be a dietitian with adequate experience of large-scale catering. Such dietitians are scarce and more will have to be trained. The catering officer should be responsible for the buying and storage of food, the planning of menus and the cooking and service. This would ensure the unification of the responsibility for catering which is essential. Another essential is direct contact with the food markets and trade, and the memorandum discusses in some detail the buying and storage of foods and the keeping of proper records. The catering officer should be responsible to the governing board through the chief executive officer and through a diet and catering committee; he should co-operate also with the medical staff, who often prescribe special diets as a part of their treatment. The catering officer would thus have considerable responsibility and his office should have appropriate dignity. The diet and catering committee would be technical and professional and would have functions, in its own sphere, similar to those of the medical committee, the ultimate responsibility resting with the board of management.

This committee would not, however, abolish the existing personal relation of the nurse and her patients. Nurses would still serve meals; but the meals would be not only nutritionally sound, but also appetizing and attractive. Such small but important details as the introduction of a little colour into a meal tray by the use of a coloured sauce receive the attention which they deserve. A section of the memorandum is rightly devoted to the diet of the doctors, nurses and others whose work creates for them dietary needs different from those of people who work outside hospitals. The ancillary reforms in the training and efficiency of all grades of kitchen staff also receive adequate consideration.

The committee hopes to see the final abolition of the practice of serving in hospitals only one cooked meal a day, so that relatives and friends of patients would no longer have to bring in supplementary foods. It is odd, however, to find that, among such supplementary foods, eggs and fruit are classed as luxuries. The specimen diets, the seven pages of recipes, the sections on menu-planning and storage of food, the wise advice about salads and raw vegetables, the tables of the nutritive values of various foodstuffs and the valuable section on the destruction of food elements, such as vitamin C, by improper cooking, will interest everyone.

The whole memorandum is so free from the fads and nonsense so often associated with brochures about food that it can be thoroughly recommended.

G. LAPAGE.

FORTHCOMING EVENTS

Saturday, December 15

ASSOCIATION OF SCIENTIFIC WORKERS, LEEDS BRANCH (at the Riley-Smith Hall, University Road, Leeds 2), at 2 30 p.m.—Second Conference on "Science and Education". Prof. J. D. Bernal, F.R.S.: "The Policy of the Association of Scientific Workers in regard to Science and Education".

SOCIETY OF CHEMICAL INDUSTRY (Joint meeting of the FOOD GROUP with the YORKSHIRE SECTION of the S.C.I. and the HULL CHEMICAL AND ENGINEERING SOCIETY, in the Lecture Theatre of the Mining Department, The University, Leeds), at 3 p.m.—Mr. J. Pryce Jones: "Honey".

Monday, December 17

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in the Lecture Theatre, Mining Institute, Newcastle-upon-Tyne), at 6 p.m—Dr W. G. Thompson· "Electronics, their Scope in Heavy Engineering".

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, South Kensington, London, S.W 7), at 8 p.m.—Wing-Commander D. C. McKinley and Wing-Commander R. Winfield "The Arctic Flights of the *Aries*".

Tuesday, December 18

SOCIETY OF CHEMICAL INDUSTRY, AGRICULTURE GROUP (in the Chemistry Lecture Theatre, Imperial College, Imperial Institute Road, London, S.W.7), at 2 30 p.m.—"Role of the Chemist in Dairying". Dr A. L. Provan : "The Chemist and Milk Production" ; Mr. E. V. Anderson · "The Chemist in Milk Processing and Manufacture".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W 1), at 5.15 p.m.—Sir Henry Dale, O.M , Pres.R.S. · "Recent Developments in Chemical Therapeutics", (iii) "Penicillin and other Antibiotics".

EUGENICS SOCIETY (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Dr. D. V. Glass : "Aspects of the Development of Population Policy".

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W C.1), at 5.30 p m.—Mrs. K. M. Trowell : "Modern African Art in East Africa".

BRITISH RHEOLOGISTS' CLUB (at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2), at 6 p.m.—Dr. E. Preston . "The Flow of Glass".

Wednesday, December 19

PHYSICAL SOCIETY, COLOUR GROUP (in the small Physics Lecture Theatre, Imperial College, Imperial Institute Road, London, S.W 7), at 3 30 p.m —Dr. W. S. Stiles : "Colour Discrimination, the Visibility Curve and the Trichromatic Theory".

ROYAL COLLEGE OF SURGEONS OF ENGLAND (at Lincoln's Inn Fields, London, W C.2), at 5 p.m.—Prof. H. Barcroft : "The Circulation in Human Skeletal Muscle".

SOCIETY FOR VISITING SCIENTISTS (at 5 Old Burlington Street, London, W 1), at 7 30 p.m.—Discussion on "Science in Australia and New Zealand" (Speakers Mr. G. B. Gresford, Dr. C. H Kellaway, F.R.S., Dr. I. E. Coop or Dr. J. C. Andrews, and Dr. F. P. Bowden).

Wednesday, December 19—Thursday, December 20

SOCIETY FOR GENERAL MICROBIOLOGY (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1).

Wednesday, December 19

At 10 a m —Symposium on "Variation of Cells having Bi-Parental Inheritance" (to be opened by Prof C. K. Ingold).

At 2.30 p m.—Symposium on "The Role, Organisation and Maintenance of Collections of Living Micro-organisms" (to be opened by Prof. Johanna Westerdijk).

Thursday, December 20

At 10 a.m —Miscellaneous Papers.

At 2.30 p.m.—Demonstrations.

Thursday, December 20

ROYAL COLLEGE OF SURGEONS OF ENGLAND (at Lincoln's Inn Fields, London, W.C.2), at 5 p.m.—Prof. O. G. Edholm : "The Circulation in Human Skeletal Muscle".

BRITISH INSTITUTE OF RADIOLOGY (in the Reid-Knox Hall, 32 Welbeck Street, London, W.1), at 8 p.m —Mr. M. H. Lupe and Mr. L. A. Kemp . "The Physicist in the Radio-Diagnostic Department".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned :

LECTURER (full-time) IN CHEMISTRY—The Principal, Acton Technical College, High Street, Acton, London, W.3 (December 21).

SENIOR RESEARCH SCIENTIST in connexion with the development of a long-term programme of research on the overseas transport of refrigerated food cargoes, and a CHIEF TECHNICAL ASSISTANT in connexion with research on the overseas transport of refrigerated food cargoes—The Secretary, Refrigerated Cargo Research Council, c/o Australian Tonnage Committee, 88 Leadenhall Street, London, E C.3 (December 22).

LECTURER IN CHEMISTRY (chiefly Organic) to Honours Degree standard, in the Constantine Technical College—The Director of Education, Education Offices, Middlesbrough (December 22).

TEACHER (full-time) OF ENGINEERING WORKSHOP PRACTICE—The Principal, Aston Technical College, Birmingham (December 22).

SCIENTIFIC OFFICER, and a SENIOR SCIENTIFIC ASSISTANT, in the Department of Agricultural Economics—The Secretary and Registrar, The University, Bristol (December 29)

ASSISTANT ENGINEER for the Iraqi State Railways—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W C.2, quoting E.2150.A (December 29).

LECTURER IN CHEMISTRY at the Military College of Science, Stoke-on-Trent—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C 2, quoting F.4645.A (December 31).

DEPUTY CHIEF ENGINEER—The Engineer, River Nene Catchment Board, Engineer's Office, Priestgate, Peterborough, endorsed 'Deputy Engineer' (December 31).

RESEARCH MYCOLOGIST to be attached to the Plant Protective Chemistry Section for investigations on laboratory and greenhouse methods for the bio-assay of fungicides, an ENTOMOLOGIST (resident in Scotland) to assist research into the causes and control of crop failure in the Scottish raspberry growing areas, a RESEARCH ENTOMOLOGIST to be attached to the Plant Protective Chemistry Section for investigations on laboratory and field methods for the bio-assay of insecticides, and a HORTICULTURIST to carry out research at East Malling and in Scotland into the propagation and cultivation of Small Fruits, with particular reference to the raspberry—The Secretary, East Malling Research Station, East Malling, Maidstone, Kent (January 1).

CHAIR OF ZOOLOGY in the University of Cape Town—The Mini of Labour and National Service, Appointments Department, Techn and Scientific Register, Room 670, York House, Kingsway, Lond W.C 2, quoting F.5269 A (January 1)

ASSISTANT LECTURER, Grade III, IN THE DEPARTMENT OF MET LURGY—The Registrar, The University, Liverpool (January 1).

CHEMIST IN THE DEPARTMENT OF DAIRY CHEMISTRY—The Secreta National Institute for Research in Dairying, Shinfield, Readi Berks. (January 1).

LECTURER IN THE CHEMISTRY AND BIOLOGY DEPARTMENT—T Registrar, Municipal College, Portsmouth (January 5).

LECTURER IN ZOOLOGY in the University of Tasmania—The Ag General for Tasmania, Australia House, Aldwych, London, W (In Hobart, January 7).

DIRECTOR OF CHEMICAL LABORATORY—must be F R.I.C. and poss the Branch E Diploma of the Royal Institute (Ref. No F 5248. and an ANALYTICAL SPECIALIST, with wide experience preferably analysis of soils, water, cement and other constructional materia petroleum products, oil seeds and cake, etc. (Ref. No. F.5249. to the Iraq Government—The Ministry of Labour and Natio Service, Appointments Department, Technical and Scientific Regist Room 670, York House, Kingsway, London, W C 2, quoting t appropriate Ref. No. (January 8).

TELECOMMUNICATIONS ENGINEER (Ref. No. D.1606.XA), a Ci ENGINEER for appointment as Area Engineer (Ref No. E.2127.X and MECHANICAL ENGINEERS (2) for Shift Work operating Stea Driven Electrical Power Plant (Ref No. C.2965 XA), by an Company in the Middle East—The Ministry of Labour and Natio Service, Appointments Department, Technical and Scientific Regist Room 670, York House, Kingsway, London, W C 2 (January 10).

ASSISTANT LECTURER AND DEMONSTRATOR IN THE DEPARTME OF PHYSICS—The Registrar, University College of South Wal Cathays Park, Cardiff (January 15).

CHAIR OF ELECTRICAL ENGINEERING—The Secretary of Univers Court, The University, Glasgow (February 11)

CHAIR OF AGRICULTURE (Animal Husbandry) in Canterbury Ag cultural College, Lincoln, New Zealand—The Secretary, Universit Bureau of the British Empire, c/o University College, Gower Stre London, W.C.1 (February 28).

LECTURER (Grade II) IN PETROLOGY AND MINERALOGY—T Secretary and Registrar, The University, Bristol (February 28).

MYCOLOGIST, and a BOTANIST, for the Rubber Research Schem Ceylon—The Chairman, London Advisory Committee for Rubb Research (Ceylon and Malaya), Imperial Institute, London, S.W (February 28).

LECTURER IN MEDICAL PARASITOLOGY—The Secretary, Departme of Entomology and Parasitology, School of Tropical Medicine, Pen broke Place, Liverpool 3 (March 1).

LECTURER (full-time) IN THE DEPARTMENT OF MENTAL HEALTH—The Secretary, The University, Aberdeen (March 23).

CROMBIE ROSS CHAIR OF MENTAL HEALTH—The Secretary, Th University, Aberdeen (March 30).

LECTURER IN BACTERIOLOGY—The Registrar, The Universit Sheffield (March 30).

FOURTH LECTURER IN BACTERIOLOGY—The Secretary, The Unive sity, Edmund Street, Birmingham 3 (March 31).

PROFESSOR OF PSYCHIATRY, and a PROFESSOR OF MEDICINE—Th Registrar, The University, Leeds (March 31).

ASSISTANT BIOCHEMIST (graduate) for Clinical Laboratory—Pro Dunlop, Clinical Laboratory, Royal Infirmary, Edinburgh.

SKILLED MECHANICS for medical research workshop—The Directo Radiotherapeutic Research Unit, Hammersmith Hospital, Londo W 12

LECTURER IN THE CIVIL AND MECHANICAL ENGINEERING DEPAR MENT (with Structures as one of the main subjects)—The Secretar Woolwich Polytechnic, Woolwich, London, S.E.18.

LECTURER IN ENGINEERING—The Principal, Leicester College Technology and Commerce, Leicester.

LECTURER IN MECHANICAL ENGINEERING SUBJECTS to High National Certificate standard in the Crewe Technical College—Th Director of Education, County Education Offices, City Road, Chest

SENIOR TEACHER OF MATHEMATICS in the Engineering Departme of the Burton-upon-Trent Technical Institute and Junior Technic School—The Secretary and Director of Education, Education Offic Guild Street, Burton-upon-Trent, endorsed 'T'.

REPORTS and other PUBLICATION

(not included in the monthly Books Supplement)

Great Britain and Ireland

Geological Survey of Great Britain : Wartime Pamphlet No. 7 High-Grade Silica Rocks of the Scottish Highlands and Islands. B Dr. J. G. C. Anderson. Second edition Pp. 32. 1*s*. 6*d* Wartim Pamphlet No. 13 : Limestones of Scotland, Area 4, South-We Highlands and Islands. By Dr. J. G. C. Anderson, with Analyses b Dr. A. Muir. Second edition. Pp. 26. 1*s* 3*d* Wartime Pamphle No. 43 : The Geology of the Northern Part of the South Staffordsh Coalfield (Cannock Chase Region). By Dr G. H. Mitchell; Pala ontology, by Dr. C. J Stubblefield, with section on Fossil Plants, b Dr. R. Crookall. Pp. 50. 2*s*. 3*d*. (London . Geological Survey an Museum, 1945.) [23

London School of Hygiene and Tropical Medicine. Report of Meeting of the Ross Institute Industrial Advisory Committee, hel in the Council Chamber of the Rubber Growers' Association, 1 Fenchurch Street, London, E.C.3, on Thursday, 12th July, 194 Pp. 22. (London : London School of Hygiene and Tropical Medicin 1945) [29

Ministry of Agriculture and Fisheries. Bulletin No. 130 : Threshin of Grass, Root and Vegetable Seed Crops. Pp. 20+3 plates. (London H.M. Stationery Office, 1945.) 9*d*. net. [29

NATURE

No. 3973 SATURDAY, DECEMBER 22, 1945 Vol. 156

CONTENTS

Page
e Food and Agriculture Organisation 727
e Pleistocene Period. By Sir George Simpson, K.C.B., C.B.E., F.R.S. 730
f-sufficient Biology. By Dr. C. H. Waddington . . 731
ees and Fungi 732
ence and Reconstruction. By The Right Hon. Sir John Anderson, G.C.B., G.C.S.I., G.C.I.E., F.R.S., M.P. 733
e Edibility of Birds. By Dr. Hugh B. Cott . . . 736
perimental Imitation of Tumour Conditions. By Dr. P. T. Thomas 738
bituaries :
  Prof. C. E. Spearman, F.R.S. By Prof. C. Burt . . 740
  Dr. Frank Chapman. By N. B. Kinnear 741
  Dr. H. E. Durham. By Dr. G. Lapage . . . 742
  Prof. C. E. Wright. By Prof. C. J. Tranter . . 742
ews and Views 743
etters to the Editors :
  Freedom for Scientific Research.—Lord Brabazon of Tara, P.C. 746
  Lognormal Distributions.—Dr. Percival Allen ; S. C. Pearce ; Prof. J. H. Gaddum, F.R.S. . . 746
  Kinematical Relativity.—Prof. E. A. Milne, M.B.E., F.R.S. ; Prof. Herbert Dingle 747
  Clock-Regraduations and Relativistic Cosmology.—Dr. T. J. Willmore 748
  Adsorption Isotherms, from Chromatographic Measurements.—Dr. E. Glückauf 748
  Efficacy of D.D.T. in Soap.—G. A. Campbell, F. C. Hymas and Dr. T. F. West 749
  Differentiation of Nuclear Substances.—Ch. Wunderly 750
  Influence of Blood Pressure and Blood Flow on the Activity of the Respiratory, Vasomotor and Cardio-Regulatory Centres.—Prof. C. Heymans 750
  Cytological Reactions Induced by Inorganic Salt Solutions.—Albert Levan 751
  Carboxylase and Carbonic Acid.—Prof. Edward J. Conway and Eithne MacDonnell 752
  Packing of Regular (Spherical) and Irregular Particles.—H. S. Leftwich 753
  Mode of Entry of Contact Insecticides.—Dr. N. E. Hickin 753
  Ergot on *Pennisetum Hohenackeri* Hochst.—Prof. M. J. Thirumalachar 754
  Classification and Nomenclature of Animal Behaviour.—Dr. J. S. Kennedy 754
  Human Chromosomes.—Prof. M. E. Varela . . 755
  Duration of Life of Woodlice.—Dr. Walter E. Collinge 755
  Steam Tables and Steam Power.—Prof. D. M. Newitt, F.R.S., and N. R. Kuloor 755
A Photo-electric Fourier Transformer. By Prof. Max Born, F.R.S., Dr. R. Fürth, and R. W. Pringle . . 756
The Newcomen Society 757
Scientific Research in India and the British Colonies . 758
Sweden's Water-power Resources 759
Non-Metallic Deposits of the U.S.S.R. By S. I. Tomkeieff 759

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THE FOOD AND AGRICULTURE ORGANISATION

THE work of the Food and Agriculture Organisation of the United Nations is so closely linked in some fields with that of the United Nations Relief and Rehabilitation Administration that the confidence in which this first of the functional organizations of the United Nations was shaped at Hot Springs in May 1943 has naturally been somewhat undermined by the chequered career of the Relief and Rehabilitation Administration and the tardiness of the United States, for example, in voting essential supplies. None the less, the firm pledges which Britain has given to the latter organization and the successful issue of the preparatory conference, which in November led to the constitution of a United Nations Educational, Scientific and Cultural Organisation, are among the pointers which warrant the hope that in the Food and Agriculture Organisation there is another functional association through which science may make an increasingly effective and important contribution to human welfare.

The appointment of Sir John Orr as first director-general of the new Food and Agriculture Organisation will be widely and warmly welcomed among men of science. It is in itself a conspicuous example of the fitness of a man of science for high administrative office ; and it also emphasizes the vital importance of scientific and technical factors in this field of agriculture, nutrition and food supply. The association of Sir John Orr with such a post suggests that in the policy of the Food and Agriculture Organisation the findings of nutritional science and human needs will be kept well in the forefront.

The United Nations Information Organisation has done well, therefore, to issue an account of the new organization*. The Charter of the Food and Agriculture Organisation was signed on October 16 by thirty nations at Quebec and a few days later was signed by the Soviet delegation, and the pamphlet gives a brief account of the work of the Interim Commission from the close of the Hot Springs Conference to the opening of the Quebec Conference on October 16 last. The Interim Commission consisted of representatives of the forty-four United and Associated Nations under Mr. L. B. Pearson as chairman, and was working at Washington six weeks after the close of the Hot Springs Conference. It has recruited a small international secretariat, and prominent scientific men and economists from many countries have given freely of their time and expert knowledge. For the first few months, the Commission concentrated on drafting a constitution and on preparing the First Report to Governments on the scope and functions of the Organisation. In this work it was aided by two panels of experts, one on the scientific aspects of food and agriculture and the other on the economic.

The Declaration drafted by the Interim Commission pledges the Governments adhering to the Organisation "to work separately and together to the end that want and the fear of want shall be progressively abolished", and for this purpose to take all measures within their power "to raise the level of nutrition and the standard of living of the peoples under their jurisdiction"; and "to improve the efficiency of agricultural production and distribution". In essence, the Food and Agriculture Organisation will attempt to marry nutrition with agriculture. On one side it is a direct outcome of the advances in the knowledge of nutrition which has characterized the last two decades. Equally, however, the Hot Springs Conference approached the problem of agricultural production in the light of the human and universal need of freedom from want, and was therefore able to bring the whole economic problem under review and to place the individual needs of producers and consumers of particular commodities in their proper perspective.

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* Towards a World of Plenty. (United Nations Information Organisation.) (London : H.M. Stationery Office, 1945.) 4*d*. net.

This was probably the greatest achievement of the Hot Springs Conference, and the reports prepared for the Quebec Conference further attest the objective approach which the Organisation is making towards the whole question and the importance of the technical and scientific contribution, from the agricultural scientific worker, the economist and the expert in nutrition. A Committee on Agricultural Production, of which first Prof. J. A. Scott Watson, and later Mr. Peters of the Netherlands, was chairman, has prepared a report on the major problems facing the farmers of the world and has made recommendations for concrete programmes of work to be undertaken by the Organisation. Under Dr. F. Boudreau, a Committee on Nutrition and Food Management is reporting on the way experience gained in war can be utilized for purposes of peace, while a Committee on Forestry, under Dr. Graves, has presented a report on world forestry and primary forest problems, and is now considering the more immediate world problems. A Committee on Fisheries under Dr. Finn, the Canadian Deputy-Minister of Fisheries, as chairman, is reporting on the fisheries of the world, and a fifth technical committee, on statistics, under Dr. Becker, is considering ways in which statistical information about food, agriculture, forestry, and fisheries can be improved.

The scientific and technical contribution from these committees is one sound reason for appointing a scientific man of outstanding administrative ability to take charge of the whole organization; and Sir John Orr's appointment may be taken as evidence of the desire of the members to see that the Organisation sets itself severely practical tasks, and that in particular it serves as an adequate and effective source of technical and scientific advice to whatever political body may be authorized by the United Nations to take executive action. 'It is of the first importance that the Food and Agriculture Organisation should secure a position of authority as an impartial source of information and advice in agricultural and nutritional matters, and the presence of a leading man of science as its director-general affords a guarantee that this primary objective will be steadfastly pursued.

There can be no question as to the value of the work which the new Organisation could do in spre ing knowledge of the best agricultural practice a technique, and in acting as a clearing house information, both practical and statistical. T backward condition of agriculture in so many pa of the world indicates sufficiently the wide field f improvement here, and if the new Organisati merely provided a meeting ground for the expe and a forum for the discussion of matters of comm concern, it might still be invaluable in furthering t aims of the Hot Springs Conference, irrespective the progress made in organizing economic relatio internationally in more general fields. But besid this, the Organisation can undertake research a lend or negotiate the services of experts for t improvement of agriculture and nutrition. O request, it may review projects for the developme of agriculture involving requests for internation loans, and it may also undertake the drafting conventions for the control of agricultural pests an diseases, the establishment of grades and standard statistical measurements and nomenclature.'

It is not belittling the contribution which th Food and Agriculture Organisation could make t point out that, where development schemes ar concerned, no major results can be obtained withou providing machinery and equipment on a large scal In countries such as India and many parts of Afric the problem becomes one of providing the means fo development, in order that the efficiency of production may be raised from its primitive level. Similarly on the side of nutrition, the elimination of malnutrition and the raising of standards of living mean th alleviation of poverty and provision of purchasin power. Here the Organisation clearly cannot tak the practical steps of subsidizing food consumptio or negotiating agreements with food producers.

The economic measures by which the increased production and purchasing power are to be secured in any particular country are matters for the Government of that country and not for the new Organisation. The value of its advice and the pressure it is able to exert will be all the greater if it can work out scales of priorities for meeting the world's hunger and want which take into account the relative and diverging interests of producers and consumers. If the Organisation, in fact, did no more than find out the size of the world's food requirements and the potentialities of its agricultural production, and then try to bring the two halves of the picture together, the world would still have ample reason to be grateful to President Roosevelt for his initiative in calling the Hot Springs Conference.

To achieve its aims, the director-general will need to see that the Organisation deals only in realities; and no efforts should be spared to achieve increased efficiency, not only in the production of the world's food supplies but also in their distribution. It is understood that before returning to England to settle up his affairs, the director-general instructed the officials of the Organisation to prepare a world-food picture, indicating the world-market situation for the next twelve months of each important commodity and the nutritional situation in every country.

this formidable task the Combined Food Board the United States Department of Agriculture's ce of Foreign Agricultural Relations are assisting. n the statistical side the new Organisation will elop and extend the useful work that was done ore the War by the International Institute of iculture at Rome, and should increasingly provide his field the factual basis for policy and practice ch Lord Woolton, in his recent presidential address the Royal Statistical Society, noted is at present king. But Sir John Orr has already indicated that main problem of the next few years, as he sees is to harness the agricultural productive capacity the Western world, increased during the War, to needs of an Eastern world which is starving but not pay for imports of food; and while the solu- n of that economic problem is a responsibility for her levels, the Food and Agriculture Organisation, a fact-finding body, can do much to demonstrate t its solution is possible. Here again, with a entific man at its head, the Organisation may well expected to lend adequate support to such methods attack as the selection in poor countries of demonation areas and in them to develop all resources the improvement of nutrition by education, cial food distribution schemes and increasing the oduction of foods, particularly protective foods, ch as milk, vegetables, fruit, fish and eggs.

No efforts should be spared to achieve increased iciency, not only in the production of world food pplies, including the development of fresh sources supply—as, for example, the exploration of hitherto touched fishing grounds—but also in their distribu- n. The importance of the latter question was ll emphasized in the Sectional Report (III) of the ot Springs Conference, and the Committee on sheries now at work may well be relied upon to port on the way in which fisheries could be opened in other waters, as has in fact been done during e War, to supplement those in the North Atlantic d North Pacific Oceans which at present provide nety per cent of the world's supply. Particularly ile the shortage of livestock persists, and also in untries where livestock industries cannot easily be veloped, such steps might provide a valuable dition to diets deficient in animal protein.

Important as is this process of fact-finding, research d demonstration of technique and practice, the ientific and technical aspects of the work of the Food d Agriculture Organisation cannot stand by themlves. Even from a wider point of view, the important ntribution to world co-operation, order and underanding which such functional organizations can ake does depend to some extent on the facilities d organization at their disposal for giving effect their findings. For that reason it is important to onsider the exact position of the Food and Agriculre Organisation in the United Nations Organisation a whole and, in particular, its relation to the conomic and Social Council in regard to the trans- tion of policy and findings into action.

For the same reason, while the Food and Agriculre Organisation has commenced by calling on the elp of the Combined Food Board, it should not be forgotten that there is evidence of a tendency to terminate as quickly as possible the agencies for collaboration set up during the War. The work of the Food and Agriculture Organisation will undoubtedly be handicapped by the recent decision to abolish the Anglo-American Middle East Supply Centre. That decision was severely criticized in the course of a recent debate in the House of Lords, and Lord Pethick Lawrence's reply to Lord Altrincham did nothing to allay the misgivings as to the termination of the valuable technical and scientific activities of the Centre. The discontinuance of these activities will undoubtedly be a handicap to the Food and Agriculture Organisation in dealing with the problems of the Middle East. The contraction of the Anglo-American Middle East Supply Centre, from a body capable of developing into a wider international regional organization, into a national one cannot but be a setback to international social and economic collaboration. The Middle East Office set up by the British Government to maintain close personal liaison with its economic and social representatives of the Middle East Governments in Teheran and to work in harmony with the Middle East States can never provide the same effective instrument which the Food and Agriculture Organisation would have found inherent in the Middle East Supply Centre.

The Food and Agriculture Organisation is bound also to be handicapped by the increase in suspicion and distrust which has marked the international situation during the last six months. An important result of the Organisation's work should indeed be the dispelling of such distrust, and the growth of co-operation and mutual understanding on the political plane through the demonstration of the value and practicability of collaboration in the attack on common problems and building up a spirit of friendship and comradeship, the importance of which was so well emphasized in the recent House of Lords debate on the international situation. In that sense the work of the Food and Agriculture Organisation is part of that larger task of re-establishing full freedom of communication and intercourse, and building up that sense of common rather than divergent interests which must form the firm basis of the United Nations or any other world organization.

We may well look, therefore, to the Food and Agriculture Organisation as one of the means for restoring understanding and for promoting the consideration of technical and economic problems from a scientific or professional point of view, free from political bias. To the extent to which it is able to do this and to put politics in the right position of serving and not, as Mr. Bevin indicated in speaking on European relief on October 26, frustrating human welfare, the new Organisation should also promote the cause of world order and peace by dispelling suspicion and enlarging the area of understanding. Clearly, too, if it is to mean anything, the investigations and advice of the Organisation must have important bearings on the formulation of agricultural policy in every country, and the importance of an adequate understanding of the new Organisation and its potentialities is not easily overstressed.

Not all the changing factors of the last two and a half years have, however, been adverse. The Relief and Rehabilitation Administration has done more solid work, in spite of limitations and difficulties, than is often recognized, in dealing with the immediate problems of which even the long-range plans of the Food and Agriculture Organisation must take account. The United Nations Organisation has come into being, and despite changes in the whole political outlook since the San Francisco Conference, the Preparatory Commission has settled to its work with surprising smoothness in London in readiness for the first full meeting of the Organisation in January. More important still, the widespread concern with the present position in Europe, and which has sometimes issued in unreasonable criticism of the activities of the United Nations Relief and Rehabilitation Administration itself, represents a consciousness of the real issues which may well prove one of the greatest sources of strength to both that Administration and the new Food and Agriculture Organisation.

The concern at the threat of famine to Europe manifested in several debates in Parliament has only been strengthened by such statements as that issued by the Ministry of Information dealing with a combined conference in Washington on problems of food supplies and distribution last April, before the close of the War in Europe, and still more by the United States report on Relief and Rehabilitation Needs of Europe and the meeting of the Relief and Rehabilitation Administration Council in London. In a debate on November 16, Mr. Noel Baker, the Minister of State, gave details illustrating the scale of the work of the United Nations Relief and Rehabilitation Administration and the speed with which its organization has responded to varied and unexpected requests; but his speech did nothing to allay the anxiety expressed in the debate that distress in Europe was overtaking the means designed to cope with it and was in danger of reaching an intensity beyond control.

The apprehension of a European breakdown is widespread, and references to it in that debate were the more emphatic because many of the speakers had lately returned from visits to Europe. In an earlier debate, on October 26, Miss Rathbone quoted Sir John Orr's opinion that "in the coming winter in Europe more will die from lack of food and shelter than were killed in the whole five years of the War"; and Sir Benjamin Smith, the Minister of Food, in urging that the supply of additional food for Europe on a scale sufficient to effect any widespread improvement in the situation must be organized on an international basis, had said that the world food-supply prospects for the coming year are seriously disquieting and that in almost all the main foods we are facing deficiencies on the world balance sheet for the next twelve months. When we add to this the limitations placed on the United Nations Relief and Rehabilitation Administration's activities—its statutes forbid it from offering relief to Germany and it is not operating in the invaded countries of western and north-western Europe—and that although the Administration has now reasonable assurance that it will be able to carry on its work until the end next year, delay in voting supply has already depri it of the opportunity of purchasing needed suppl there can be no room for doubt as to the desper seriousness of the situation and that we are s threatened with the victory of destruction.

Unless, indeed, we can avert from Europe—a that must include Germany—the twin menace epidemic disease and social chaos, the Food a Agriculture Organisation will have no opportunity functioning effectively. It is not easy to convin public opinion that everything possible has been do to reduce the danger of disease and social uphea to a minimum. That is one reason why Sir Arth Salter's request for the publication of a White Pa which would help to form sound judgment by givin clear statement both of the needs of Europe and of t resources available to meet them is thoroughly sou

Such a statement, to the extent that it wou enable opinion to be formed on the basis of inco trovertible facts, should be specially welcome scientific workers, who in this field have no sm responsibility in forming and guiding public opinio and above all in emphasizing the physical, ment and psychological consequences of failure to p adequate attention to the nutritional requiremen and of allowing a state of starvation or semi-starv tion to intensify and spread in Germany and Europ But measures to mitigate the existing conditions w not by themselves be entirely adequate. Beyo that, as the Foreign Secretary has emphasized, w have to eliminate the paralysing effect of fear a revival of the German menace. That fear is st the greatest obstacle to confidence and co-operatio and to dispel and eliminate it will be one of th greatest tasks of the United Nations and all i functional organizations. The immediate nee is to prevent the onslaught of famine and econom chaos. While that is being done, the Food an Agriculture Organisation must be formulating i plans for long-term developments; and with i practical objectives, it may well play an importa part in stimulating that international co-operatio which is essential for the well-being of mankind.

THE PLEISTOCENE PERIOD

The Pleistocene Period

Its Climate, Chronology and Faunal Successions. B Dr. Frederick E. Zeuner. (Ray Society Volume 13 for the two years 1942 and 1943.) Pp. xii+32 (London: Bernard Quaritch, Ltd., 1945.) 42*s*.

THERE must be many students who, like mysel being interested in some geophysical problem the Pleistocene period and not satisfied with th conclusions given in the text-books, have turned t the original papers to find exactly the evidence o which those conclusions were based. Anyone wh has had that experience knows how difficult it is co-ordinate the original papers: the evidence is part geological, partly biological, partly cultural; t nomenclature is varied and often of local significanc the evidence is fragmentary, no one geologic section giving the whole history, so that exposures e region have to be matched against those of other, giving play to opinions rather than facts. oraines in one place have to be co-ordinated with ver terraces elsewhere, and these again with raised aches far away ; and one has always to consider the ssibility of tectonic changes of the surface layers. is a great example of not being able to see the wood r the trees, and one has longed for a clear map of e 'woods' with the 'trees' marked in their proper aces and each kind of 'tree' labelled with a name hich does not change from place to place.

The great merit of Dr. Zeuner's book is that it does st that, and I for one must admit that when I had ished reading it I had a clearer picture of the quence of events during the Pleistocene period and the evidence on which that picture is based than I as ever able to get from all the original papers of hich I have read so many. The book is easy to ad for such a complicated subject, is on the whole ell arranged and what is more important it gives the idence largely direct from the original sources. The bliography is full (but why is it subdivided accord-ng to chapters, which makes it difficult to find an em and involves much cross-referencing ?) and the dex is adequate. It is a book that every student of e Pleistocene will enjoy reading, if for no other ason than that for once both 'woods' and 'trees' can e seen in their true perspective.

Having said so much in praise of the book, it must ot be assumed that I agree with all Dr. Zeuner's onclusions. Neither Dr. Zeuner nor anyone else has id the last word on the Pleistocene ; and the main roblem of all, the causes of the great changes in limate, is still open to discussion. Dr. Zeuner has dopted the radiation theory, in which the changes n climate are ascribed to the inequalities and perturb-tions of the earth's orbit ; in fact, it may truthfully e said that the whole book is written around this heory, and it is because he has such a clear aim whether it be true or not) that he has been so success-ul in giving a connected picture. It must be admitted hat he brings a great deal of evidence to support his ontention, and I can quite understand that it will arry conviction to many readers. This is not the lace to discuss the evidence in detail, but I cannot efrain from saying that the supporters of the adiation theory would have been in a stronger osition if it had been found that the first three laciations had each two peaks and the last glaciation hree peaks before Milankovitch had produced his adiation curve and not after. If the evidence for he radiation theory marshalled by Dr. Zeuner stood lone, it would be difficult not to accept it ; but it oes not stand alone ; there are many questions of hysics involved, and these, as I have tried to show lsewhere, give answers which are completely opposed o the theory. On one hand, we have the similarity more or less) of two curves, and on the other ertain objective facts of radiation and energy ; if he latter cannot be reconciled with the theory, then he former means nothing.

As I have already mentioned, one of the great ifficulties in the study of the Pleistocene has been he want of a uniform nomenclature, and this is articularly the case in the designation of the uccessive glacial phases. Having reached the onclusion, by aid of the radiation diagram, that here have been four main glaciations during the leistocene, Dr. Zeuner naturally wished to give hem suitable names. When, forty years ago, Penck nd Brückner were faced with the same problem in the case of the four glaciations they had discovered in the Alps, they reached a very practical solution : they chose for each glaciation a short name taken from a region where evidence of that glaciation was present ; the initial letter of each name was alphabetically in the same order as the series of glaciations starting from the earliest : thus we have Günz, Mindel, Riss, Würm. This committed them in no way to the number of glaciations : if new ones were discovered, new names in the same alphabetical series could be chosen to designate the new glaciation ; there are plenty of vacant spaces. Thus one had a flexible system of names, each short and its initial letter giving its position in the series without excluding possible future additions. The abbreviations G. M. R. W. are concise and unmistakable. For the interglacials Penck and Brückner simply stated the two glaciations between which they fell, thus giving : Günz–Mindel Interglacial, Mindel–Riss Interglacial and Riss–Würm Interglacial, which were abbreviated to G–M, M–R, and R–W, the form of which shows at once that they refer to interglacials.

In choosing his new names, Zeuner has departed entirely from this practical system and has designated his four glaciations Last, Penultimate, Antepenultimate, and Early ; while he designates the three interglacials by the same adjectives. The glaciations are abbreviated to LGl, PGl, ApGl and EGl respectively, and the interglacials to LIgl, PIgl, and ApIgl. With regard to the names of the glaciations : they are not short (Antepenultimate Glaciation is particularly awkward) ; they are not flexible (but by aid of the radiation diagram Zeuner is convinced that no further glaciation will be discovered) and the introduction of the purely English words 'Last' and 'Early' makes the series unsuitable for international use. The abbreviations are particularly unsatisfactory : they are long and there is nothing to show at a glance which are the abbreviations of glaciations and which of interglacials ; for example, ApIgl and ApGl, the former being an interglacial and the latter a glacial ; they should be compared with G–M and M. Considering that Zeuner is satisfied that Penck's four glaciations are identical with his own, why should he not have adopted their names ? They are known to everyone who has read the most elementary text-books on the Pleistocene and they are suitable for use in every language, to say nothing about giving honour where honour is due.

These blemishes, though not small, do not rob the book of its value and I am convinced that many well-read students of the Pleistocene will enjoy, as I did, this bird's-eye view of the most interesting of all geological periods. G. C. SIMPSON.

SELF-SUFFICIENT BIOLOGY

The Directiveness of Organic Activities

By Dr. E. S. Russell. Pp. viii+196. (Cambridge : At the University Press, 1945.) 8s. 6d. net.

DR. RUSSELL'S book is concerned to establish "the conclusion that directiveness and creativeness are fundamental characteristics of life, shared by no inorganic system ; that they are not to be explained in terms of mechanism or of purpose ; that human directiveness or purposiveness in thought and action are a specialised development of the directiveness and creativeness inherent in life" (p. 178). Its purpose is primarily philosophical, to develop a mode of approach to the problems of biology. However, its method, perhaps wisely, is not dialectical; instead of presenting a close train of argument, Dr. Russell indicates, by descriptions of actual examples, what he means by "directiveness". Look, he says, at this regenerating flatworm or developing egg; naïvely beheld, they cannot but seem to strive towards a well-recognized completeness, which is their goal. Consider again the ability of rats to choose, from an array of purified substances, just those which together make up a perfect diet; or the fact that a rabbit, which reacts to a loss of blood by rapidly making more, and to the transfusion of extra blood by getting rid of the excess, nevertheless does neither of these when the loss is rapidly followed by a transfusion; is it not clear, Dr. Russell asks, that it is the need of the organism, rather than any mere physico-chemical stimulus, which determines the animal's behaviour ?

The examples are not always convincing. For example, rats may, as is asserted, be able to pick out for themselves a perfect diet, though the matter is still, I believe, under discussion; but there is no doubt that many other animals cannot. Again, it is difficult to see why, on any reasonable hypothesis, a rabbit should show any marked reaction to an experimental series of bleedings and transfusion which end by restoring the *status quo ante*. But undoubtedly, Dr. Russell can adduce many remarkable biological phenomena which, as he puts it, "are directive towards ends of self-maintenance, development or reproduction". It is difficult not to admit some degree of astonishment at the performance of the minute worm *Microstoma*, which eats *Hydra*, digests all but the sting-cells (nematocysts), and from these selects the varieties with the greatest offensive power (rejecting the other sorts through the mouth), and finally arranges to shuffle these captured weapons through the thickness of its body wall until they reach the surface, where their captor can use them for its own purposes. Such things, to use a cliché, would seem to demand an explanation.

The most unsatisfactory feature of Dr. Russell's book is that he makes no attempt to provide an explanation in other than self-consciously "biological" terms, or even to discuss the explanations which most biologists nowadays advance. "As a philosophy materialism is merely absurd," he asserts, "why then base biology upon it" (p. 2). "For such understanding we require a free biology, with laws and concepts of its own, independent of those of the physical sciences, based upon an objective study of the directive activities of organic agents, unrestricted by the hampering mechanistic hypothesis which is at the back of the causal-analytical method" (p. 4). It may be granted that, whatever a "free biology" may be, specifically biological laws may be quite useful tools of thought. Even the application of straightforward teleology is a quick rule of thumb which often works. And biologists, still without reaching the domain of physics, can rely on a much subtler form of explanation, the appeal to natural selection and the gene.

Russell scarcely mentions either of these fundamentals of biological thought. His only reference to the gene is to classify studies on "the presumed action of genes on development" among the "analytical and disintegrative" physico-chemical investigations which miss the point of "the organism as a living, developing, reproducing whole" (p. 2). This is odd; not only because he allows (p. 158) that those other, one would have thought equally mechanistic, agents, evocators and growth-hormones, do contribu to "a biological account"; but even more becau the modern view of an organism in terms of its gen would seem much more closely akin, philosophicall to his own ideas than was the usual biological pictu of, say, thirty years ago. In his summing up, Russ applies to the living organism a saying of Spinoza's "The effort by which each thing endeavours to persi in its own being is nothing else than the actual essen of the thing itself". As we should put it: the actu essence of the thing itself is to be found in the gen which control its synthetic activities, and whic being capable of maintaining their own specificity b self-reproduction, direct this synthesis always int the paths which are characteristic of that particul organism.

Thus an outlook which stresses that developme and self-maintenance are essential characteristics organisms is in no way in opposition to curre biological thought; but that body of thought ha already gone further than Dr. Russell in relatin these aspects of life, through the concepts of th gene and of natural selection, to the rest of Natur

C. H. WADDINGTON.

TREES AND FUNGI

Trees and Toadstools

By Dr. M. C. Rayner. Pp. 71+18 plates. (London Faber and Faber, Ltd., 1945.) 6*s*. net.

IN this book the general results of investigation carried out over sixty years by a great number o workers is brought together and presented in a forn that should appeal to the layman. It concerns th structure and nutritional relationships between th green and the non-green plant when the connexio is not one of host and parasite but a delicatel balanced relationship in which each partner has share.

The first chapters give an outline of the physio logical processes of green and non-green plants an form a useful introduction to the more comple relationships discussed later in the book. This lead on to a consideration of soil problems and the par played by the micro-fauna and flora in the breakin down of humus.

After this introduction, the author gives a de scription of the toadstools of woodlands with th structural features of their mycelia and the part they play in the soil and in the higher plants.

The later chapters give an interesting account o the fungus roots of coniferous and some other tree and discuss the different types of mycorrhiza an their reciprocal relations with higher plants. Th researches of the author have contributed much t our knowledge of some of these problems; but man of the complex relationships are still unknown an occur not only in plants living in soils rich in humu but also in plants living in the desert where humu is almost absent. Dr. Rayner has given an outlin of the technique necessary in these investigation but has confined her descriptions mainly to th macroscopic features, and this part of the book con tains some excellent photographs from her own an some other sources.

The book gives a well-balanced description of th problem as it stands to-day in regard to conifers, and has provided a new meaning for the layman of th striking display of toadstools in our woodland during the autumn months.

SCIENCE AND RECONSTRUCTION*

By The Right Hon. Sir JOHN ANDERSON, G.C.B., G.C.S.I., G.C.I.E., F.R.S., M.P.

MY interest in science dates back to the early years of this century when, having secured a holarship of sufficient value to enable me to devote year or two to further study abroad, I went to ermany to engage in postgraduate research in ysical chemistry. As it happens, the subject lotted to me was an investigation of the radio-tive properties of uranium, a curious coincidence view of certain activities in which I have recently en engaged.

I had previously, while still an undergraduate in dinburgh, become somewhat concerned about the onomic prospects for specialists in natural science. had noticed, for example, that, apart from school-astering and the limited establishments of the ience departments of the universities, there seemed be no demand in Britain for chemists. Things deed were still much as Lavoisier found them when, ving been condemned to death and being disposed protest, he was informed coldly that the world ad no need for chemists. The War Office assessment the value of trained chemists was expressed in 905 in the offer of a commencing salary of £130 a ear. The only industrial openings one heard of ere occasional vacancies in breweries, and those ually went to well-trained specialists from Denmark. The fact is that, at that time, the staple dustries of Britain still relied on the traditional ethods which had served them well before inter-ational competition became acute. I well remember arning from a schoolfellow the horror with which is father, the proprietor of a famous tannery, had ceived the suggestion that he should introduce a w trained chemists into his tanyard.

However, youth is generally optimistic, and it was ot until I had been at work for some time and ound that my researches were proceeding rather owly—as was bound to be the case from what we ow know of the nature of the subject—that my ind began to dwell again on the prosaic question earning one's living. On reflexion, it was borne upon me that, while my research work was subject no time factor, I was approaching the age limit r entry into the Higher Division of the Civil Service. decided that I had better try for that before was too late, and thus have no occasion to regret aving missed an opportunity that would never recur. n the result, I was awarded a position as a "2nd ass Clerk in the Colonial Office"—such was the nimaginative and even repellent terminology then vogue—and the whole tenor of my life was changed.

This fragment of autobiography enables me to ring out two facts that are not without interest relation to the subject of my address. The first that a good grounding in natural science can be passport to the higher Civil Service, equally with e more usual training in the humanities, or in the istory schools. The second, as exemplified in my wn case, is that public administration does provide ope, apart from the professional or specialist ades, for men with a scientific training. For example, at the beginning of the War of 1914–18, we ere confronted with a serious situation owing to the dden cutting off of all supplies of those synthetic drugs and other fine chemicals and dyestuffs for which we had allowed ourselves to become entirely dependent on Germany. I was made responsible for organizing measures for making good the deficiency so far as the medicinal requirements of the country were concerned, and I was also in continuous consultation with those who were dealing with the explosives and dyestuffs situation. It would take too long to describe the nature of the action that was taken—and taken successfully—to overcome what might have been a fatal handicap in that conflict, but I certainly could not have played my part had it not been for my earlier training. Much more recently that training has again stood me in good stead in discharging the responsibilities that fell to me as Lord President of the Council, leading up to the work on atomic energy to which I am still giving part of my time.

After this rather lengthy introduction, I come to my main subject—science in relation to reconstruction. The restoration of the economic life of Britain, and even the maintenance of the living standards established pre-war, is dependent on building up our industries to a level of efficiency higher than ever before attained. We have, to a large extent, lost the competitive advantage which our mineral resources and sea-power gave us in the halcyon days of last century. It is a further disadvantage that the exports which we must have in order to pay for vital supplies of food and raw materials are so much greater in relation to the corresponding home demand than in the case of either the United States or the U.S.S.R. It is on the quality of our products that we must rely to overcome all disadvantages, and to this end we must build up the finest possible bodies of technicians and make the fullest use of all new developments to which science can point the way. There is no reason to doubt our ability to do this if we know where the obstacles are and show a determination to remove them.

It has long been the fashion to decry our achievements in the field of applied science in the past, though in pure science they are, of course, universally recognized to have been outstanding. This has, no doubt, been in part a pose, exemplifying our well-known habit of self-depreciation. But, in my view, we have, in fact, lagged behind, and for two main reasons—partly because of the dead hand of tradition in our older industries and partly because of prejudice on the part of scientific men themselves. The profit motive was suspect in the higher academic circles before it became an object of attack in politics. The author of one of the most fundamental, and, as it turned out, most fruitful discoveries in electrical science plumed himself on the fact that it could be of no possible use. We must get rid, and we are getting rid, of all that nonsense so far as scientific workers are concerned.

I have said that we have lagged behind in the past; but things were never so bad as is sometimes made out. It is true that, apart from certain traditional lines such as acid and alkali production, chloroform, a few alkaloids and a very narrow range of dyestuffs such as alizarin (turkey red) and azo dyes (khaki) we had no chemical industry at the outbreak of the War of 1914–18. But, as I have already indicated, much was done during that War to overcome the initial handicap, and what has been achieved since—up to the outbreak of the recent War and during its progress—is full of encouragement. That was only to be expected in the case of the great new electrical and chemical industries which had their foundations in scientific discoveries; but the older industries can also show many notable instances of a fresh outlook. Let me give a few illustrations in both categories.

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* Address before the Manchester Joint Research Council at Manchester delivered on December 6.

In the textile industries, before the War, both uncreasable cotton and unshrinkable wool had been produced as a result of prolonged researches and, during the War, cotton fabrics have been produced in large quantity in which the fibres are so twisted that, on contact with water, they immediately swell and render the cloth waterproof, while at the same time allowing the passage of air.

In the steel and non-ferrous metal industries new processes have been developed and new materials produced for the first time, including many types of alloy steel, and great quantities of magnesium metal from sea-water.

In television we undoubtedly led the world before the War and we are probably still ahead. In the various applications of radio-location, founded upon investigations originally conducted under the Radio Research Board of the Department of Scientific and Industrial Research, we were in almost every instance well ahead of all competitors. Here is a magnificent example of co-operation between science and industry, resulting in the production of power valves working on wave-lengths of a few centimetres—a development undreamt of a few years before.

Between the Wars, Britain gained all the speed records in the air, on water and on land, with British pilots and British machines made in British workshops. We now hold all these records again.

All aeroplanes are fitted with perspex—the transparent non-splintering plastic produced in Britain—and, during the War, our chemical industry produced also polythene—the finest insulator known—without which some of the most important applications of radio-location would have been impossible.

An insecticide (gammexane) probably more efficient than D.D.T., a range of selective weedkillers, linked with the discovery of the hormones produced in the growing tips of plants—which may well mean a revolution in agricultural methods—a synthetic adhesive, heat-, water- and acid-proof, giving unions stronger than those obtained by riveting or spot welding, are other achievements of our progressive and virile chemical industry.

The 'Mosquito', produced straight from the drawing board, largely by coach-building and furniture factories, and made operational in the record period of twenty-two months, could carry the same weight of bombs to Berlin as a 'Flying Fortress', with a crew of two instead of ten, and at 100 miles an hour faster. The British-made 'Lancaster' carried the biggest bomb-load and was the only aircraft capable of carrying the 10-ton bomb. Between 1939 and 1944 the Merlin engine was doubled in horse-power and performance, without any increase in weight, and we have recently read with pride what they think of it in the United States.

In the manufacture of scientific instruments, where during the First World War we found ourselves sadly behind, there is the same story of technical skill and successfully applied research. Our bomb-sights and predictors, containing incredibly delicate and complicated mechanism, were nevertheless robust enough to be carried in our bombers, and simple enough in operation to be used by technically unqualified personnel.

The measures to combat the magnetic mine—perhaps our greatest anxiety in the early months of the War—the prefabricated breakwaters and harbou known as "Gooseberry" and "Mulberry", and t submarine pipelines for carrying petrol to t Continent, are other outstanding examples of tec nical achievement.

The illustrations, which I could multiply ma times over in respect of a wide range of activitie show the high technical efficiency of British industri and their readiness to appreciate and develop ne ideas born in our research laboratories. I give the now merely in order to establish my contention th the prognosis in this matter of the application science in industry during the period of reconstructi is extremely favourable.

If that is accepted, let us look a little farther t see what is still needed in order to make the most our resources, actual and potential, and of our oppo tunities. This is the kernel of our problem, and I wi deal with it under the three heads of: (1) personne (2) finance and (3) organization.

Personnel. Sir Ernest Simon has directed attentio to the discrepancy between the numbers of scientifi ally trained personnel turned out by the universiti and other teaching establishments in the Unite States and Great Britain respectively. Allowing, of course one must, for the difference in total popul tion, we come very badly indeed out of the com parison. No doubt we make up to some extent i quality for lack of numbers; but the fact seems i disputable that the output has, in the past, bee far below what the real needs of the countr demand.

Clearly the deficiency, whatever it may be—an some further investigations seem called for under th head—cannot be made good all at once. The firs step must be to enlarge the capacity of our teachin institutions, to get more scientific men of high qualit back from war service to the teaching staffs of th universities, and then further to expand their number in the appropriate branches and perhaps to exten classroom and laboratory accommodation. This wi require some order of priority, and I have little doub that Mr. Morrison was right when he said re cently that the needs of industry must at first giv way to some extent before those of the universitie Then the necessary steps must be taken to increas the flow of students—not just any sort of student but students of the right type—with the best kin of general educational background. Some prop aganda will be needed here. I, personally, though it unfortunate that so little was made of the import ance of scientific and technical education during th passage of the Education Bill last year. I think great opportunity was lost; but no harm may resul in the long run if we do now what is urgently needed and that is to prepare the best possible estimate—quantitative and qualitative—of future requirement Universities, industrial firms and all other potentia employers, including the Government, should make and make known, their plans, indicating the type and numbers of trained men and women they require the terms they offer and the kind of organizatio they propose. Such information, properly collated will be an indispensable basis for the work of th committee on scientific priorities which Mr. Morriso recently announced in Parliament, and will als provide the necessary material for an approach t headmasters and, through them, to parents. As first step one cannot go wrong in urging that every thing possible should be done to hasten the release o trained scientific workers and of partly trained an trained students from the various forms of war rvice.

Finance. I come now to a matter which I would nk as high in importance as that of personnel— nance. Here I may modestly claim to have myself azed a trail. Broadly speaking, research and de- lopment must be financed in one or more of the llowing ways: by industrialists, either in their own boratories or through industrial research associa- ons, or through grants to universities and other ientific institutions; by universities and other ientific institutions out of their own resources; by overnment, through research institutions of its own, through grants to industrial research associations, individual workers or to universities.

While I was still Lord President, the basis of grants research associations was reviewed by the Advisory ouncil of the Department of Scientific and Industrial esearch, under Lord Riverdale, and now arrange- ents have been made which represent a very sub- antial improvement on the old. Whereas the epartment used to work on the principle that a overnment grant would be available only until the ssociation could be made self-supporting, the prin- iple of a permanent grant is now accepted, and the asis of calculation has been liberalized. This marks fundamental change in outlook. Government rants to universities are made through, and on the ecommendation of, the University Grants Com- ittee, which has been reconstituted to bring it into oser touch with the universities. About a year ago, met the Committee of Vice-Chancellors and fore- hadowed a substantially increased rate of grant hich has now been voted by Parliament for the urrent year. In addressing them, I referred, in articular, to the need for a revision of university alaries, and I made it clear that, for the first time his year and in future, capital expenditure would be aken into account in assessing grants. It is left to ach university to allocate its grant as it thinks fit, ubject, of course, to any general understanding etween that university and the Committee. Grants armarked for specific researches are made not by he Committee but by the Department of Scientific nd Industrial Research, with the approval of the reasury. The Department also administers a scheme f maintenance grants for postgraduate students to llow them to be trained in methods of research.

Expenditure by industrialists is assisted not by irect grant but by a system of tax relief. Up to his year, maintenance expenditure in connexion ith research was allowed as a deduction from earn- ngs, in accordance with the usual principle, but no llowance was made in respect of expenditure of a apital nature. Under my Budget proposals of last year, to which statutory effect has now been given, ll research expenditure in connexion with any par- icular industrial undertaking is allowed as a de- luction from earnings before assessment of tax. This pplies to all expenditure on buildings, plant and equipment, and represents a clear departure from the hitherto sacred principle that untaxed income must not be used to produce additions to capital ssets. The same principle is applied to contributions by industrial firms to research associations or universities for research. The value, and of course the cost o the taxpayer, of such relief can be gathered from the contributions of this character which have already been made. For example, I.C.I. have given eighty fellowships at universities, of an average of £600 a year each, for research in physics and chemistry, and sciences derived therefrom, including engineering and chemotherapy. There are no restrictions or conditions attached to these fellowships. The Shell Group has made a gift of £435,000 to the University of Cambridge for a Department and chair of Chemical Engineering, together with a yearly grant of £2,500 for scholarships, and Courtaulds have given £118,000 for a similar purpose to the Imperial College of Science and Technology. I do not doubt that, as time goes on, many other similar grants will be made, thus adding greatly to the funds available for fundamental research. Of the funds devoted by the Government to research in its own institutions, little more need be said except that experience goes to show that there are certain forms of fundamental research which it will probably be agreed can be only satisfactorily developed in this way. I mention, by way of illustration, the work to be carried on in the new Aeronautical Research Establishment at Luton, and the future of research into the uses of atomic energy.

There seems to be little doubt that the expenditure directly incurred by the Government on research will increase substantially as time goes on. I hope in the summary I have given I have succeeded in showing that, so far as financial aid is concerned, we now have a framework within which all that is required can be secured.

Organization. The efficient use of our resources, limited as they must be for a long time to come, demands the best possible organization. Without seeking to dogmatize in any way, I would suggest the following: (*a*) There should be recognized standards of remuneration. (*b*) Conditions of service should be such as to facilitate interchange between establishment and establishment, and between one type of service and another. A uniform pensions scheme, such as the Federated Universities Superannuation Scheme, should help to this end. (*c*) Free exchange of information and ideas should be encouraged. (*d*) Without encouraging teaching institutions to undertake agency or contract work, research in applied science in such institutions should not be discouraged. (*e*) Similarly, the advantage of allowing a certain amount of fundamental research in industrial research establishments should be recognized. It should be remembered that it is to research, so conducted, that the discovery of the gas-filled lamp, which has meant an enormous annual saving in consumption of electricity, is due. (*f*) To prevent wasteful overlapping, the various industrial associations should establish special committees to discuss long-term programmes of research with representatives of the universities and the Government research organizations. In this connexion the question as to what fundamental researches can most profitably be conducted in Government establishments, or centrally in selected institutions, should be considered.

These are only suggestions which I hope may be thought worthy of further consideration; but, before leaving this part of the subject, in which my aim has been to indicate a number of questions which I think bodies such as the Manchester Joint Research Council might usefully explore, particularly in their regional aspects, it is right that I should say a word about the question of organization, so far as the arrangements of the central Government are concerned. I would unhesitatingly reject the suggestion, much canvassed of late, that there should be a Minister of Science. If we believe, as we must, that science enters into nearly every branch of human activity, there can be scarcely a Minister or a Department that is not interested in some way in the applications of science, and to add a super-Minister with general responsibilities and executive functions in relation to science could only lead to confusion. But that does not mean that I should be content with things as they are. We now have, in the Lord President, a Minister who is directly responsible for the general, as distinct from the departmental, scientific activities of the Government—the Department of Scientific and Industrial Research, the Medical Research Council, and the Agricultural Research Council. If a similar Council were set up for the social sciences, he would no doubt take that under his wing also. He has, during the War, been the channel of communication between the Scientific Advisory Committee and the Cabinet. I should like to see three changes made. First, I would have the Lord President formally recognized as the Minister responsible for dealing, on behalf of the Cabinet, and subject, where necessary, to reference to the Cabinet, with all general scientific questions in which the Government is concerned, including problems of organization, arrangements for Commonwealth or international conferences, and so forth. Secondly, I would continue the Scientific Advisory Committee, which was a special war instrument, on a peace-time footing, with some extension of personnel, as the principal adviser of the Lord President and the Cabinet in scientific matters. Thirdly, I would create a special section of the Cabinet secretariat, under an officer of appropriate qualifications and seniority, to assist the Lord President in the discharge of his new responsibilities. I believe, under arrangements such as these, the organization of the central Government would be suitably geared into the general complex of scientific organizations throughout the country.

Now I propose to say something about the position of our investigations into the use of atomic energy, and particularly about the prospects of industrial use. We have here a case where, as the result of a quite prodigious concentration of effort, such as could only have come about under the spur of war, results have been achieved in a few years which, in ordinary circumstances, would have taken perhaps ten times as long, or even longer. The work that has been done, of which I have some detailed knowledge, points clearly enough to certain lines of development in the future. I say nothing about the military problem. So far as industrial applications are concerned, it is quite certain that nothing has been discovered to justify the expectation that the energy released by an atomic explosion could be used directly as a source of industrial power, as, for example, the explosion of gases is used in an internal combustion engine, or a gas turbine, or in certain forms of rocket. The only method which existing knowledge suggests as practicable depends upon the conversion into heat of the energy released by a controlled process of nuclear fission. There is no difficulty in realizing this experimentally. But at the very outset practical troubles begin to arise. The first problem is to get the heat in a convertible form. This means a high temperature and involves very efficient controls and special measures to prevent corrosion of the metallic components and the rapid disintegration of the whole system.

The other major problem arises in connexion with the intense and very dangerous radiation by which the nuclear reaction is attended. This means elaborate shielding devices and a complete system of remote control. It would be absurd to suppose that these and other difficulties will not be overcome time, and there is always the possibility of so fundamental new discovery completely changing t character of the problem ; but the best opinion I c offer—and it is not based on my own conclusion b on the conclusions of those on whose judgment can most confidently rely—is that it will be man years before nuclear energy comes on the market, f any but the most limited and specialized purpos in competition with existing sources of power.

Nevertheless, the ultimate possibilities are su that it is clearly incumbent upon us as a nation devote all the resources we can spare to furth researches in this field. There will, I imagine, I little doubt that the Government must, for the tin being at any rate, take a leading part in the organiz tion of such researches. Nevertheless, I must stre the fact that these recent discoveries open up a enormous new field of scientific work, and shou give tremendous impetus to research by physicist chemists and engineers. Indeed, the matter go much farther, for the devices that are employed t produce the new element plutonium provide a read means of procuring a vast range of new radioacti substances, including radioactive forms of commo elements used in medicine. For example, radi phosphorus, radio-iron, radio-sodium and many oth substances can now be administered with the norm substance in proportions too small to be harmfu and their radioactive properties can be used to determ ine the exact behaviour of the particular therapeuti or nutrient agent in the human or animal organism It does not require much knowledge, or much imag ination, to realize what a revolution this may brin into medical science. In plant and animal physiolog it may be equally important. There are also no available many alternatives to radium which ma be both much less expensive and more manageabl in radio-therapy. Thus, what may prove to be a uncovenanted benefit of inestimable value accrue to humanity as a by-product of the search for furthe means of destruction—proving again the truth of th saying that science often bestows her boons wher no one planned.

THE EDIBILITY OF BIRDS

By Dr. HUGH B. COTT

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IN the autumn of 1941 I happened to be preparing some bird-skins at Beni Suef, Middle Egypt, when a casual observation led to what has proved a somewhat fruitful and little-explored line of inquiry. A palm dove (*Streptopelia senegalensis*) and a pied kingfisher (*Ceryle rudis*) had been skinned and the carcases thrown aside. Hornets were very plentiful in the garden where I was working and soon collected on the meat; but they were seen to concentrate their visits on one carcase, leaving the other almost neglected. Closer inspection showed that it was the dove that was receiving their attentions: with the kingfisher they would have little to do.

This apparent preference for one bird of the pair suggested further investigation, and it was decided to test the edibility of a wide range of birds, using *Vespa orientalis* as an indicator. Innumerable observations and experiments have hitherto been made n the palatability of various groups of animals—notably insects—with special reference to the theories of concealing and warning coloration and mimicry[1a]; but so far as I am aware, birds have remained largely neglected in this respect. The experimental method here adopted is an inversion of that so frequently used, in which birds have played the part of taster in investigations on the palatability of insects.

During the period 1941–44 many experiments were carried out, both in Egypt and the Lebanon, as a result of which it has been possible to assess the relative edibility of some forty species of birds in terms of hornet-preference. As the work developed, it became clear that the preferences of the insects were not dissimilar from those of other and quite unrelated meat-eaters such as the domestic cat and man. Details of this research will be published elsewhere: it is only possible here to refer briefly to some points of interest.

Among the birds tested were members of several Passerine families, including larks, wagtails, bulbuls, flycatchers, warblers, finches, buntings and swallows, together with birds of other orders including wryneck, hoopoe, buff-backed heron, white stork and little owl. One broad conclusion to be drawn from this work is that in the birds used there appears to be a relationship between edibility of the flesh and visibility of the plumage.

When arranged in order of preference, it is found that the species heading the list are those with the most effective concealing coloration, wryneck (*Jynx torquilla*) and crested lark (*Galerida cristata*) taking first and second place. Reading upwards from the bottom of the series we have the following: white-rumped black chat (*Oenanthe leucopyga*), pied kingfisher, mourning chat (*O. lugens*), masked shrike (*Lanius nubicus*), hoopoe (*Upupa epops*), hooded chat (*O. monacha*), golden oriole (*Oriolus oriolus*), red-backed shrike (*L. collurio*), lesser grey shrike (*L. minor*), European swallow (*Hirundo rustica*), common kingfisher (*Alcedo atthis*), red-rumped swallow (*H. daurica*)—all birds which in the field are highly conspicuous, the chats referred to being black-and-white deserticolous species.

Two striking exceptions to this general statement were provided by the buff-backed heron (*Ardeola ibis*) and white stork (*Ciconia ciconia*), both of which are extremely conspicuous and at the same time relatively palatable. It will be noted that both are large birds, which by reason of gregarious habits in the first case and powers of defence in the second are presumably not much subject to predacious attack in Nature.

This inverse relationship between edibility and visibility appears to occur in certain cases even within the limits of a family. For example, the finches and a bunting tested are found to stand in the following order of preference: greenfinch, house sparrow, Spanish sparrow, Cretzschmar's bunting, goldfinch, the last being rated least acceptable. Similarly, the blue-headed wagtail appears to be preferred to the white wagtail.

Experiments with the preferences of the cat for birds of various species have not yet reached a stage which would justify drawing any general conclusions; but it may be mentioned that in some instances the cat seems to be in close agreement with the hornet in his notion of what is fit to eat. For example, cats rate the pied kingfisher, hoopoe and a black-and-white chat (*O. finschii*) as relatively distasteful compared with sparrows, doves and other birds.

When we turn to the preferences of man, it becomes apparent that the birds—of many groups—which are most prized for the table are those which are specialists in cryptic camouflage; it is only necessary to mention a few: Passeres (skylark[2a], meadow lark[3]); Columbiformes (various fruit pigeons such as *Osmotreron pompadora*[4] and *Vinago delalandii*[5]); Charadriiformes (American golden plover[6] and grey plover[7], woodcock[8], common snipe[2b], stone curlew[9], bronze-wing courser[10a]); Gruiformes (bustards[2a,10b,11] and floricans[12,13a]); Galliformes (notably grouse and quail); Anseriformes (teal, mallard*, gadwall and others); Caprimulgiformes (European nightjar[16]).

Conversely, there is some evidence that numbers of highly conspicuous birds belonging to many different orders are definitely unfit for the table: sheld-duck[14], crocodile bird[15], magpie[16], and swallows being examples, though there are, of course, notable exceptions, such as the rook and starling, which make tolerable eating. Furthermore, here again within certain natural groups of birds the general correlation obtains. To take one example, among the Ralliformes, landrail[13b], clapper rail[17], and Carolina crake[18] are highly palatable and cryptic in coloration and habits; coot[19] and moorhen[18], though 'eatable', are scarcely accountable as table-birds and are among the most conspicuous members of the order.

Thus there would seem to be some evidence that the correlation above referred to is fairly general among birds as a class, and these facts would appear to bring birds into line with other groups of animals such as the Anura[1b] and Insecta[1a], in which the relationship between edibility and cryptic coloration on one hand and between certain classes of conspicuousness and unpalatability on the other, has been well established.

I am at present collecting further information on the above subject and would be glad to hear from members of expeditions, travellers, sportsmen and others who have tasted birds—of whatever kind—which are *not* usually considered as game. Such information is infrequently included in ornithological literature and would be welcomed as a contribution to the present investigation.

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EXPERIMENTAL IMITATION OF TUMOUR CONDITIONS

By DR. P. T. THOMAS

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THE cancer investigator is primarily concerned with the nature and origin of uncontrolled growth in malignant tumours which depends on an aberration of normal cell division. The processes which underlie normal cell division and differentiation, however, are still far from being well understood. Cytology, so long as it remained a descriptive science, made little progress in this direction. But the change which occurred some fifteen years ago, when its methods became analytical and experimental, has by now made possible the interpretation of some growth processes in physico-chemical terms[1]—an advance which has in its turn stimulated a greater co-ordination among the different methods of approach to the cancer problem. Especially this advance has confirmed the remarkable uniformity of nuclear behaviour throughout living organisms. Experimental work on widely different organisms can therefore now be used to contribute to our understanding not only of normal but also of abnormal growth.

The condition of malignancy is accompanied by well-defined cytological changes, most of which have long been known[2,3,4]. The following are the most conspicuous: (1) 'hyperchromatism'—increase in size of chromosomes and a higher staining capacity; (2) enlarged nucleolus; (3) increased basophily of the cytoplasm; (4) increase in cell and nuclear size and a greater variability in both; (5) wide variation in chromosome number; (6) defect in the spindle at mitosis with its consequences.

Although different tumour types vary in detail, all malignant tissues and most malignant cells show one or more of these abnormalities which serve to distinguish them from the normal. Thus the difficulty of the cytologist has not been so much in distinguishing between normal and malignant cells but in deciding: (1) if there is any causal sequence among these various abnormalities; (2) if any of them can be regarded as a specific criterion of malignancy.

Failure to answer these questions has led to much confusion and differences in interpretation. The easiest way to find an answer seems to be to try to separate the particular abnormalities experimentally. We must try to induce them in non-malignant tissue in order to determine their immediate causes, from which it should be possible to establish the probable sequence of events in tumours.

A good deal of evidence is already available in support of the view that nucleic acid supply is the crucial factor in the causation of cancer. This view has developed largely from the work of Caspersson[5], Darlington[6], Claude[7] and others who have demonstrated the significance of nucleic acids and nucleoproteins in cellular activity.

We are concerned with two types of nucleic acids:

(1) *Ribose nucleic acid*, produced apparently by the heterochromatic regions of the chromosomes and found in the nucleolus and in the cytoplasm. This acid is closely associated with protein synthesis and especially with reproduction of self-perpetuating protein elements in the cytoplasm. It can be identified, with the help of a ribo-nuclease check, by staining with pyronin by Pappenheim's pyronin-methyl green technique.

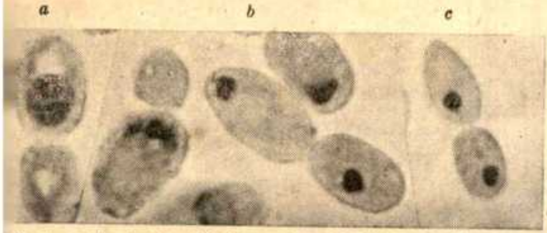
(2) *Desoxyribose nucleic acid* is produced during th prophase of mitosis, becomes attached to the chrom somes and is responsible for their reproduction. A the same time the nucleolus, with its store of ribo nucleic acid, dissolves and disappears. After th chromosomes have divided and reformed as daught nuclei they give up most of their charge of desox ribose nucleic acid, which is again reconstituted ribose nucleic acid in the developing nucleolu Desoxyribose nucleic acid gives the characterist aldehyde reaction with Schiff's reagent which is th basis of Feulgen's technique for chromosome stainin

The two nucleic acids are thus mutually (althoug not directly) convertible, and in normal tissue are s balanced that chromosome reproduction and cyt plasmic synthesis are in step. Caspersson conside that this balance is maintained by the regulatin action of heterochromatin[5], which under norm conditions allows the synthesis of the correct amoun of nucleic acid. Any increase in activity or in amoun of heterochromatin will, on this view, lead to excessiv nucleic acid synthesis and increase in the rate nuclear division.

Koller[8], from a cytological study of human tumour finds support for this view. Thus malignant cells hav a much enlarged nucleolus and a highly basophili cytoplasm because of the higher concentration of ribos nucleic acid. In the same way the 'hyperchromatism by which cytologists have described the larger an more deeply staining chromosomes is due to a heavie charge of desoxyribose nucleic acid. Confirmation o this interpretation has recently been obtained by L Cour[9], who found that in the unbalanced differentiation of cells in pernicious anæmia, nucleic aci supply in the red corpuscle precursors is increase and that in the white diminished.

We may now consider two experiments in which a least certain aspects of the primary change to malignancy is imitated. The first was with *Sorghu purpureo-sericeum*. Here the presence of supernumerary heterochromatic chromosomes is accompanied by a striking change in nuclear behaviour i the developing pollen[10]. Normally the first polle grain division which produces the vegetative an generative nucleus is followed after a week by th division of the generative nucleus to give two sperms But in pollen grains with extra chromosomes th vegetative nucleus immediately divides again an continues to divide until it has produced four or fiv generative nuclei. These divisions would presumably continue further but for the thick wall which confine the growth within the grain and makes it an 'encapsulated tumour'. Thus a nucleus which normally would not divide is induced to divide again and again owing to the action of extra heterochromatin introduced by a chromosome change.

The second experiment consists in the induction o giant mutant forms in yeast by the action of chemical carcinogens and camphor[11,12]. For example, Thaysen and Morris[12], by subjecting cultures of the non-sexual *Torulopsis utilis* to the action of camphor for several days, obtained a mutant in which the average cell volume was about double that of the normal. The generation-time for this new *major* strain ranged between 58 and 90 minutes as compared with 100–110 minutes for the standard strain. It was also found that "the percentage of nucleic acid extractable from a given weight of cells of the new strain was considerably higher than that obtained from the standard *Torulopsis utilis* strain". In agreement with this, the phosphorus content of the mutant strain, calculated



ig. 1. *a*, *Torulopsis utilis* VAR. *major* SHOWING LARGE FEULGEN-EGATIVE NUCLEOLUS AND CRESCENT-SHAPED FEULGEN-POSITIVE HROMOSOMES; *b*, VAR. *major* AND, *c*, NORMAL STRAIN SHOWING IFFERENCE IN CHROMOSOME SIZE. ALL PREPARATIONS STAINED WITH FEULGEN FOLLOWED BY ACETIC-LACMOID. (× 2000).

m the dry yeast, was 2·8 per cent as compared th 1·8 per cent for the original strain. Through e kind co-operation of Dr. Thaysen and his col- gue, I was able to study the two strains cytologic- y. I found that the nucleolus in the *major* strain s more than four times the volume of that in the ndard strain. Moreover, as can be seen in Fig. 1, e two Feulgen-positive bodies, which can be pro- rly regarded as chromosomes[13], are also greater in e. They presumably have an increased nucleic acid arge. Further, in a culture of the normal strain ich had been under the influence of camphor for o days, the mutant forms could be readily identified their staining. They showed increased basophilic action with Pappenheim's pyronin methyl green lution. They had a higher concentration of ribose cleic acid.

Thus in four respects, rapidity of division, increase size of nucleolus, and concentration of nucleic ids of both kinds, the mutant yeast cell exactly rees with a cancer cell. The change produced by mphor, as Thaysen remarks, is "deep-seated" or netic since the mutant form is stable and has not verted to the normal after continued subculturing. e action of camphor on yeast, therefore, has been to induce a specific effect on growth, by increasing nucleic acid metabolism. But here the change, although genetic, is probably not due to change in the chromosomes but rather to one in cytoplasmic determinants. The change is analogous to that of carcinogens in causing cancer in animals.

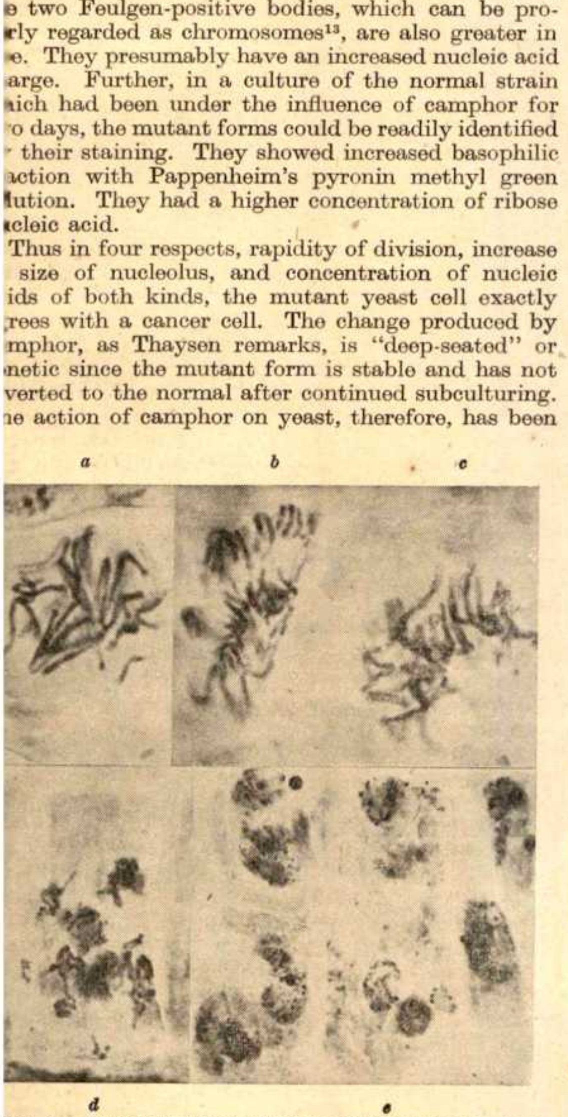


Fig. 2. ACTION OF LACTIC ACID ON ROOT-TIP TISSUE IN RYE (18 HR. TREATMENT WITH 250 P.P.M. *p*H 5·66. 28° C.). MULTIPOLAR SPINDLE AT EARLY ANAPHASE, *a*; LATE ANAPHASE, *b*; METAPHASE, *c*; TELOPHASE, *d*; WITH CONSEQUENT MULTINUCLEATE CELLS AS AT *e*. (× *c*. 1000).

Perhaps the most striking cytological abnormalities in tumours are those due to defect in the spindle at mitosis. In fact Boveri[14] originally thought that the multipolar spindle was a primary cause of tumour formation; but we now know that initially cell division is by normal mitosis and these abnormalities are absent or very rare in many types of tumours. They therefore seem to be secondary.

The spindle can be upset in normal tissue by a number of physical and chemical agents, producing effects which imitate the behaviour in tumours. The more effective agents, such as colchicine, cause complete suppression of the spindle, apparently by preventing the orientation of its long-chain molecules. The less-effective agents induce a multipolar spindle by preventing the co-ordination of partially orientated spindle elements. Complete suppression of the spindle leads to polyploidy, while partial suppression results in hypo-diploid nuclei and multinucleate cells. Both these conditions occur in tumours with the expected results. The latter is the commoner and is probably the main cause of cell degeneration.

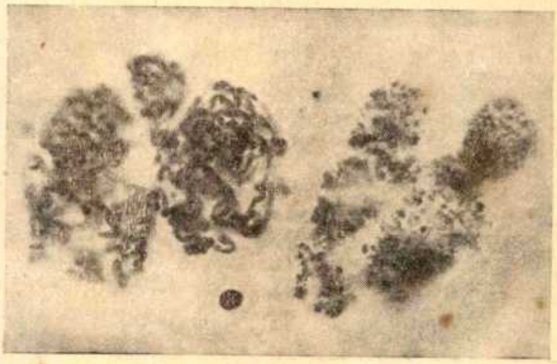
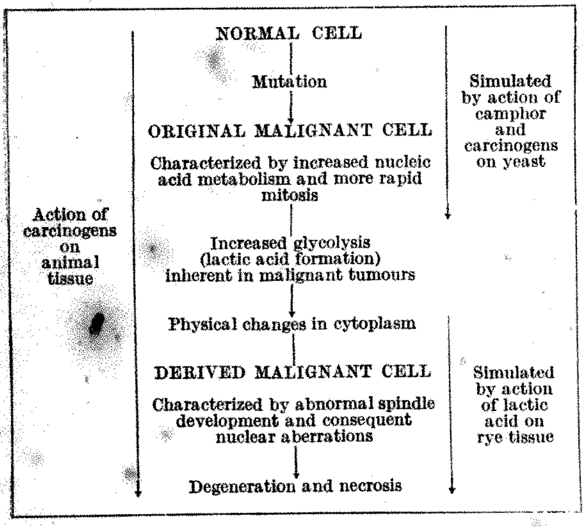


Fig. 3. AFTER 24 HR., SHOWING IRREGULARLY SHAPED POLYPLOID NUCLEI AT RESTING STAGE AND AT PROPHASE. THIS TYPE OF NUCLEUS IS OFTEN FOUND IN TUMOURS (*cf.* REF. 4, P. 257). IT RESULTS FROM A MULTIPOLAR SPINDLE. (× *c*. 2000.)

One of the less effective agents is lactic acid. Its action can be shown readily on root-tip tissue in rye. The abnormalities produced closely resemble those in malignant tumours (Figs. 2 and 3). The precise mode of action of lactic acid on the spindle will be discussed elsewhere. The action seems to be the same as that which Heilbrunn[15] terms "reversible coagulation of the cytoplasm" observed by him when studying the action of fat solvents and heat. The term "thixotropic setting" which Seifriz[16] uses for the action of anæsthetics in producing a reversible gelation of the cytoplasm probably refers also to the same physical change.

Now the accumulation of lactic acid, due mainly to aerobic glycolysis, is regarded as "the outstanding metabolic characteristic" of tumour tissue[17]. Hochwald[18] and Reiss[19] had already concluded that lactic acid was the cause of the central necrosis in tumours. More recently Guyer and Claus[20], from viscosity measurements, suggested that this acid might be the agent which induces the mitotic abnormalities by causing partial coagulation of the cytoplasmic proteins. We may therefore suppose from these different kinds of evidence that lactic acid is the immediate cause of spindle defects in tumours. The question as to whether the formation of lactic acid in the tumours is itself secondary and a consequence of excessive growth activity, or whether it is bound up with the primary change in nucleic acid metabolism, does not now need to concern us.

To summarize, we may arrange, as in the accompanying table, the probable sequence of events in tumour development.


NORMAL CELL
Mutation
ORIGINAL MALIGNANT CELL
Characterized by increased nucleic acid metabolism and more rapid mitosis
Increased glycolysis (lactic acid formation) inherent in malignant tumours
Physical changes in cytoplasm
DERIVED MALIGNANT CELL
Characterized by abnormal spindle development and consequent nuclear aberrations
Degeneration and necrosis
Action of carcinogens on animal tissue
Simulated by action of camphor and carcinogens on yeast
Simulated by action of lactic acid on rye tissue

The change from a normal to a malignant cell is of the nature of a mutation, but until recently we had few ideas as to how it might be brought about. We have seen that a change in the amount of heterochromatin may be one way and we also know that mutation in a single nuclear gene may induce polymitosis[21]. We now have the further possibility of an effect through mutation in cytoplasmic elements. In this there is a remarkable similarity of views between two workers engaged in entirely different fields of research. Darlington[22], basing his arguments primarily on cytogenetic grounds, considers that there are genetically important elements in the cytoplasm which are self-perpetuating. These he calls plasmagenes. They differ from viruses in their adaptation to the 'host' and in their interaction with the cell nucleus. Both plasmagenes and viruses depend on chemical equilibrium for their continuance, so that a mutation in them can alter not only their equilibrium but also their interaction with the cell nucleus. Potter[23], as an enzymologist, considers that cancer is caused by the introduction of "an abnormal protein" which he calls a "cancer virus" and which he assumes "to arise spontaneously in certain cases, to be formed by the action of carcinogenic agents in other cases and to be introduced into the cell in the case of tumours known to be of virus origin". This 'cancer virus' is assumed to be almost identical with an enzyme *X* which he believes is a complex of respiratory enzymes of the nature of a ribonucleoprotein. A change in equilibrium is brought about by competition between these two for the same 'building blocks', and when the ratio $\frac{\text{cancer virus}}{\text{enzyme } X}$ reaches a certain value the cell becomes malignant. The change is thought to be irreversible because the 'cancer virus' competes more successfully than enzyme *X* for the 'building blocks'. The reaction analogous to what Darlington calls 'suppressivene as between plasmagenes.

These experiments and theories seem to show th a common basis has been reached for the study the cancer problem. They seem to show also th the elements of the problem can be pulled apa robbed of their complexity and subjected to prof able experimental tests that will now have a meanin

I am much indebted to Mr. S. H. Revell for tec nical assistance with some of the experiments d cussed in this article.

Note added in proof. Since the above article w written, Potter has also directed attention to th remarkable coincidence of views in *Science*, **101**, 6 (1945).

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OBITUARIES

Prof. C. E. Spearman, F.R.S.

Charles E. Spearman was born in London September 10, 1863. He came of a Northumberla family, the more prominent members of which ha been either Army officers or mining engineers. Wi one or other of these possible professions in view, gave himself assiduously in his early youth to t study of applied mathematics. Eventually he enter the Army, and served in the Burmese War. Duri the Boer War he was deputy assistant adjutan general in Guernsey; and in this way becan interested in problems of personnel. He resigned h commission in order to study experimental psycholog at Leipzig, at Göttingen, and at Würzburg.

Spearman's interests first centred on the proble of determining sensory thresholds. Here his math matical knowledge enabled him to suggest sever improvements in the psycho-physical methods Wundt and Muller. But, coming as he did with mature experience of practical affairs, he quick decided that the experimental psychology of tho days was engrossed too exclusively with questio far removed from those of ordinary human life. H early aim, therefore, was, in his own phrase, " connect the psychics of the laboratory with those of real life".

The idea of using sensory thresholds to measure general ability or intelligence he took from Galton. In the United States, one of Galton's own pupils, J. McKeen Cattell, had applied laboratory tests to students, and, on assessing the results by Galton's method of correlation, had been surprised to find that the agreement of the various modes of assessment was extremely low. Cattell, Thorndike and others were consequently led to the conclusion that there was no general faculty of intelligence, as Galton had assumed, and that the mind was a "host of particular abilities". This negative result Spearman believed to be erroneous. Adapting a more elaborate statistical procedure from Karl Pearson and Yule, he endeavoured to eliminate the irrelevant factors which appeared to be obscuring the underlying correlations, and then found an almost perfect agreement between the various tests and assessments. These results he published in one of his earliest and most important articles in 1904—"On General Intelligence Objectively Determined and Measured". In this research he believed he had demonstrated "the profoundly important conclusion that there exists something which we may provisionally term general sensory discrimination" ; and this he identified with "general ability" in Galton's sense. Few papers in psychology have given rise to such productive controversies and to so long a list of suggestive investigations.

In 1907 Spearman returned to England. At that time McDougall was interested in Galton's scheme for an anthropometric survey which should include intelligence tests. In France, Binet had produced his scale of tests ; and at University College, London, Karl Pearson had already been working with correlational methods applied to teachers' assessments of their pupils' mental characteristics. On McDougall's recommendation, Spearman was appointed reader in experimental psychology at the same College, and four years later became Grote professor of mind and logic. During the next twenty years, he and his research students were systematically engaged on demonstrating the supreme importance of a general intellectual factor, which he himself preferred to call, not intelligence, but *g*.

At first Spearman relied mainly on sensory tests of a laboratory type—the æsthesiometer, Galton's cartridge weights, and a dichord of his own invention for testing discrimination of pitch. Other workers in Great Britain, however, showed that better results might be secured by using tests of more complex abilities, particularly those involving the perception or use of logical relations, such as could be given without apparatus to large groups of children in school. These suggestions Spearman readily incorporated. His main interest, however, lay rather in the theoretical study of the mind in general than in educational or other practical applications.

His later work with tests of this new type led him to formulate his "fundamental noegenetic principles". According to this doctrine all intellectual processes were to be conceived as depending essentially upon the "education of relations and correlates". His first book, on "The Nature of Intelligence and the Principles of Cognition", gave a systematic picture of the workings of the human mind based on this hypothesis. It was quickly followed by a second volume on "The Abilities of Man", which gave the final statement of his 'two-factor theory'—the theory that all mental processes are pervaded by a single central function, combined with a second highly specific factor peculiar to each test or trait.

Later, in a smaller work on "The Creative Mind", Spearman endeavoured to show how his fundamental noegenetic laws could be applied to other intellectual fields. His last work, "Psychology Down the Ages", was a historical study in two volumes of the evolution of the chief doctrines of psychology, with the intention of showing how nearly all the more acceptable formulations were dim foreshadowings of his noegenetic laws.

In 1931, on his retirement, Spearman was made emeritus professor in the University of London. He had already been elected a fellow of the Royal Society, and been honoured by numerous scientific bodies in Germany, France, the United States and Czechoslovakia. All who worked with him, or discussed with him their common problems, will testify to his remarkable gift for inspiring enthusiasm both in his own colleagues and pupils and in those who were drawn to criticize his views. Few have possessed his power of co-ordinating and concentrating the interests of numerous research workers on a single fertile scheme.

C. BURT.

Dr. Frank Chapman

THE death has been announced of Dr. Frank Chapman, who for many years was head of the bird departments of the American Museum of Natural History, until his retirement in 1942.

Dr. Chapman was born at Englewood, New Jersey, on June 12, 1864, and on leaving school entered a New York bank. So keen on birds was young Chapman that he used to get up at daybreak, hunt birds on the way to the station, where he would arrive at 7.30, change into his city clothes and catch the 7.39 to town. All his spare time was devoted to collecting and studying birds, and after six years in the bank he decided that was not the life he could live. In 1886 he left the bank and two years later was appointed assistant to Dr. J. A. Allen, curator of mammals and birds in the American Museum of Natural History. This was the beginning of his long connexion with the Museum and the great bird collection which was so wonderfully developed under his charge. When Chapman joined the Museum the study collection consisted of only 300 skins ! Under the joint care of Allen and Chapman the collection grew apace, and the latter made many expeditions to different parts of the States and the West Indies to secure further material.

Early in his career Chapman became interested in the life zones of the Andes, and thereafter most of his work was devoted to studying the birds of the Andes in Venezuela, Colombia, Chile and Peru. He published several monographs dealing with the subject and was the recognized authority on the birds of these regions. As Chapman himself wrote, he was more interested in watching live birds in the field than in collecting or studying skins, and after the First World War he settled on an ideal spot for the purpose. This was Barro Colorado Island in the Panama Canal zone, and there he built a house, called Fuertes House, after his friend the American bird artist. Here he could study and photograph wild life to his heart's content. Among the trees toucans, guans, parrots and woodhewers abounded, and down below were ocelots, peccaries and other interesting mammals. The joys of the place and what can be seen are described in "My Tropic Air Castle".

The love of birds brought Theodore Roosevelt and Chapman together, and through Roosevelt he was invited by Lord Grey to the British Embassy to talk birds. Later, during visits to Great Britain, he was taken by Lord Grey to see birds in the New Forest and along the banks of the Itchin, and a few years after he paid a visit to Fallodon which is vividly described in the "Autobiography of a Bird Lover".

Chapman was an ardent protectionist and for many years edited *Bird Lore*, the magazine of the Audubon Societies. In 1893 he published a useful "Handbook of Birds of Eastern North America", a revised edition of which appeared in 1912.

To Chapman the American Museum owes the development of the habitat groups for which that Museum is so famous.

In 1898 Chapman married Miss Embury, and the marriage was an ideally happy one, his wife developing as keen an interest in birds as her husband and often accompanying him in the field. N. B. KINNEAR.

Dr. H. E. Durham

BY the death at Cambridge, on October 5, of Dr. Herbert Edward Durham both bacteriology and botany lose a distinguished discoverer. Durham was born in London in 1866. He was the son of A. E. Durham, senior surgeon to Guy's Hospital and a grandson of William Ellis, the economist. Educated at University College School and King's College, Cambridge, Durham took first class honours in Parts I and II of the Natural Sciences Tripos at Cambridge in 1890, his medical qualification in 1892 and his F.R.C.S. in 1894. In 1894 he was appointed to a Gull Research Studentship and went to Vienna to work in Gruber's hygiene laboratory. There he and Gruber first directed attention in January 1896 to the diagnostic value of the agglutination of pathogenic organisms by the sera of animals immunized against them. Later in 1896 this test was applied by Widal for the diagnosis of typhoid fever. The reaction was known for a time as the Gruber-Durham reaction and later as the Widal reaction.

In 1896 Durham was appointed a member of a Royal Society committee upon diseases transmitted by tsetse flies. In 1897, while holding a Grocers' Scholarship and working at Cambridge, Durham described the Durham tube, a small inverted test-tube placed in bacteriological media for the collection of the gas produced by fermentative organisms. In 1900 he headed the expedition sent by the Liverpool School of Tropical Medicine to Brazil to study yellow fever. Durham contracted the disease, but lived to lead, during 1901–3, the expedition sent by the London School of Tropical Medicine to Christmas Island and Malaya for the study of beriberi. From Malaya, Durham brought home samples of *Derris elliptica* and appears to have been the first to recognize the insecticidal properties of this plant.

In 1905 Durham was appointed supervisor of the laboratories of Messrs. H. P. Bulmer and Co., of Hereford, where he worked for thirty years upon problems of fermentation and apple culture in relation to cider production. In 1909 he took his Sc.D., Cambridge, and in 1935 retired to Cambridge, where he cultivated, in his garden there, many culinary plants and herbs which are rare in Great Britain. Many of these he had himself introduced, and several Cambridge gardens still cherish those which he gave to their owners.

A retiring man who could be a charming and humorous companion, Durham acquired a wide culture and was always ready to give of his rich store of experience to his many correspondents and friends. He sent many valuable contributions to the "Dictionary of Gastronomy". Responsible for much original work, and also for much stimulation of others, he scattered his knowledge in private communications and did not always obtain full credit for his discoveries. Not least among his later activities were his hobbies of photography and lathe-work. While his bacteriological work is well known, his contributions to botany, and especially perhaps to apple culture and problems of fermentation, merit wider recognition. The sympathy of everyone will go out to Mrs. Durham, who survives him, and to his brother, Colonel F. R. Durham, secretary of the Royal Horticultural Society. G. LAPAGE.

Prof. C. E. Wright

THE death of Prof. C. E. Wright, professor of gunnery and mathematics at the Military College of Science, Woolwich, occurred on October 30, 1945.

Charles Edward Wright was born on January 31, 1886. He studied mathematics at King's College, London, between 1903 and 1906, where he was awarded the Clothworkers' and Sambrooke Exhibitions and a Drew Gold Medal. After graduating he was appointed tutor at University Correspondence College, Cambridge. During the War of 1914–18 he served with the Royal Engineers and was, for a short time, at the Research Department, Woolwich. He obtained the degree of M.Sc. by examination at Queen Mary College, London, in 1921.

In 1919, Wright took up the appointment of senior lecturer at the Military College of Science, Woolwich, where he spent the greater part of his career and where he was appointed professor shortly after the retirement of Prof. H. C. Plummer in 1940. Wright was wholeheartedly devoted to the instruction of army officers to fit them for technical staff appointments. The many students who have worked under him have proved their value during the recent War, where their services have proved indispensable in the development and production of weapons to meet the needs of the soldier in the field. Apart from his professional duties, Wright was actively engaged in voluntary war work, but alas, his zeal was greater than his strength.

He was an able mathematician and, in addition to his instructional duties and the preparation of Service text-books on ballistics, he found time to write several papers and notes published in the *Philosophical Magazine* and educational journals. The elegance exhibited in some of his mathematical work is most attractive. He was of a cheerful disposition and was popular with students and staff alike. C. J. TRANTER.

WE regret to announce the following deaths:

Dr. E. F. Armstrong, F.R.S., on December 14, aged sixty-seven.

Mr. A. Lucas, O.B.E., sometime chemist to the Egyptian Department of Antiquities, on December 9, aged seventy-six.

Mr. F. Milsom, for many years the official referee for Hepatics for the British Bryological Society, on December 5.

NEWS and VIEWS

Geological Survey (Scottish Office)
Dr. Murray Macgregor

The retirement of Dr. Murray Macgregor during the past autumn brings to a close a long and eventful term of office in charge of the Geological Survey in Scotland and north-east England. On joining the staff in 1909, Dr. Macgregor was stationed at Edinburgh, and in 1921 succeeded the late Mr. L. W. Hinxman as district geologist for the Central Coalfield and Northern Highlands; and in 1925 he was appointed assistant director for Scotland. Dr. Macgregor has rendered signal service both in organizing and personally conducting geological investigations for industrial developments in Scotland. He will, however, be remembered especially for the close contact which he maintained with those engaged in the coal-mining industry. In addition to his many contributions to the economic geology of the coalfields in Survey memoirs he has written a comprehensive account of Scottish Carboniferous stratigraphy, which was published by the Geological Society of Glasgow in 1930. During the past twenty years a large programme of normal survey work was carried out under Dr. Macgregor's guidance. The first revision of the Scottish and Northumberland Coalfields was completed, as well as a second revision of a large part of the Central and Lothians Coalfields and the oil-shale field of the Lothians. Up to the outbreak of war in 1939, striking progress had also been made with the primary survey in several areas in the Highlands and Islands. During the war years the activities of Dr. Macgregor and his staff were concentrated upon economic aspects of geology, related to the War itself and to reconstruction. A number of special investigations were carried out at the request of several ministries and to meet various industrial needs. Among these may be mentioned a detailed examination of Scottish limestones, mainly for agricultural purposes, a search for feldspar, silica-rock, mica and iron ore, surveys of underground water resources and of areas for open-cast coal production, and an investigation of building materials, including slates, brick-clays and granite.

In addition to his Survey duties, Dr. Macgregor has contributed largely to scientific journals and to the work of scientific societies. He has served as president of the Edinburgh Geological Society and the Geological Society of Glasgow, as editor of the *Transactions* of the latter Society over a long period of years, and as member of council of the Royal Society of Edinburgh. He is a vice-president of the Geological Society of London. In 1941 he was awarded the Murchison Medal by the Geological Society of London, and in 1944 the Clough Medal by the Edinburgh Geological Society.

Mr. T. H. Whitehead

Dr. Murray Macgregor is succeeded at Edinburgh by Mr. T. H. Whitehead, who joined the Geological Survey in 1914. During the First World War he served in the Suffolk Regiment, reaching the rank of captain, was severely wounded and afterwards was appointed to the Intelligence Staff. Among his important published work is the Geological Survey memoir on the South Staffordshire Coalfield, in which he collaborated with T. Eastwood, now assistant director in England; other memoirs of which he is a principal author are those on Coventry, Birmingham, Stafford, Wolverhampton and Shrewsbury. In 1933 he was transferred to the Manchester branch office, and from 1935 until it was closed in 1938 he was in charge of that at York. During the War he has been the district geologist responsible for urgent revision work on the coal and other resources of the Midlands, and for the six-inch survey, now completed, of all the Jurassic and Cretaceous iron-ores south of the Humber. Whitehead's judicial mind and terse clarity in argument are acknowledged and admired by his colleagues of the Survey and Museum, whom he has served well both as counsellor and advocate, and by his fellow-members of the Council of the Geological Society. These qualities, coupled with his extensive and intimate knowledge of British geology and its economic applications, make him admirably suited for his new post.

University of London, Institute of Education :
Prof. Karl Mannheim

Dr. Karl Mannheim has been appointed to the chair of education in the University of London, in succession to Sir Fred Clarke, who retired at the end of the last academic year. The appointment dates from October 1, 1945, and is tenable at the University Institute of Education. Mannheim's appointment may be regarded as both daringly original and a sign of the times. A Hungarian by birth, he gained his doctorate in philosophy at the University of Budapest, and was becoming known as a sociologist of repute while teaching in Germany before 1933. The events of that year brought him to Britain, and to a lectureship in sociology in the London School of Economics. In 1940 his impressive study of "Man and Society in an Age of Reconstruction" established him in the front rank of sociologists, and the collection of essays he published in 1943 under the title of "Diagnosis of our Time" enhanced an already considerable reputation.

Mannheim has always shown himself peculiarly sensitive in his sociological studies to the importance of education, and since 1941 has been attached to the staff of the London University Institute of Education, but can scarcely be regarded as possessing the normal professional qualifications for a professorship in the subject. Paradoxical as it may seem, this is probably why he has been appointed. The Institute, under the leadership of Sir Fred Clarke, has in recent years been laying increasing emphasis on the social aspect of public education, and insisting that the philosophy of education must be worked out on a sociological basis. No one is better fitted to undertake this task than Mannheim.

Benjamin Rush (1745-1813)

Born on Christmas Eve two hundred years ago, Benjamin Rush remains one of the most versatile and colourful personalities in American history, and the greatest physician America has produced. One of the signatories of the Declaration of Independence, treasurer of the U.S. Mint, founder of the American Anti-Slavery Society, advocate of prison reforms, it is upon his reputation as a physician that his immortality rests. His account of the yellow fever epidemic which swept Philadelphia in 1793 won him international fame, while the singular courage and the untiring devotion to duty which he displayed in attending to its victims raised him in popular imagination to the stature of a hero. His descriptions of cholera infantum and of focal sepsis—he was one of the first to recognize the relationship between infected teeth and arthritis—have become medical classics. Though many of his theories are to-day of historic interest and many of his therapeutic measures have been discarded, his title 'father of American psychiatry' is justified, for his "Medical Inquiries and Observations upon the Diseases of the Mind", published the year before his death, was the first American text-book on psychiatry, and he was a pioneer in the humanitarian treatment of the insane and an early advocate of occupational therapy in asylums. A magnetic teacher, an elegant speaker and a felicitous writer, Benjamin Rush was a pronounced individualist, who made enemies as well as friends. He was one of the greatest 'bleeders' in the annals of medicine.

The Good and the Clever

It was a happy inspiration which caused the Master of Balliol to base his Memorial Lecture at Girton College, Cambridge, upon the verses in which Miss Wordsworth referred to the possible antithesis between goodness and cleverness, when "the good are so harsh to the clever", and "the clever so rude to the good". He set out to show that nothing will make sense of the distinction, except to acknowledge that goodness is in its own way as rational as cleverness. "Let us begin with the Greeks," said he to his hearers, and then, as became his learning and his office, he took them through a fascinating journey from the Greeks on to the Renaissance, and thence to Rousseau, Kant and Bentham. Naturally, those of his hearers who had studied philosophy to some purpose must have got most out of this part of his discourse; but none of them could have missed the heart of his theme, which was that "the really good man may not be learned or intellectual, but though he need not be clever he is not stupid. He has the imaginative power of putting himself in other people's places, and of going right past differences of rank and wealth and ability and all else, and getting to the essential human being". One remark will be of special interest to readers of this journal, devoted to science in its broadest interpretation. "Psychological classifications, case papers, and all the elaboration of card indices does help one to deal more effectively with people, but the most elaborate and scientific analysis misses out the authentic individual, just exactly what goodness should have the power of apprehending. If we only deal with people as specimens of this or that, sorted out in the most elaborate of ways . . . can we retain that reverence for the human personality as we meet it in ordinary men and women which is essential to any true service. . . . Good and noble work has been done in that way, but not the best." It must have been a salutary experience for members of the particular audience addressed to be so effectively reminded that good men and women are sometimes also exceedingly wise, and that clever men and women can sometimes also be exceedingly unwise.

"Faraday's Encyclopedia of Hydrogen Compounds"

The scope of this important new aid to using chemical literature has already been explained in *Nature* (April 21, p. 467). Dr. Faraday and his publishers are to be congratulated on the fulfilment of their promise to keep it up to date by producing the first instalment of supplementary pages. This is no mean achievement in relation to the well-known difficulties of the moment with which printers and publishers are faced. The single sheets of the first replacement addition issue (C_1—C_5) cover the year 1944 and bring the book up to January 1, 1945 (Chemindex, Ltd., Manchester 2. Pp. 64. 15*s*.). We know of no other book of reference in science which is in this happy position. On trial, it was found that the necessary work of changing the sheets and adding new ones took less than half an hour; the instructions given are so precise that any intelligent person can follow them. The new matter fits easily into the system and only three correction sheets were required, which is a testimony to the care taken in the original preparation. A leaflet enclosed with the sheets promises a second volume dealing with C_6 and C_7 shortly, while others are ready for the printer: we believe the practising organic chemist will be eager for these. It is of interest to note the degree to which the various abstract journals cover the published literature. A spot test of a random sample has shown that *British Chemical Abstracts* covered 27 per cent, *American Chemical Abstracts* 57 per cent and *Chemisches Zentralblatt* 70 per cent. On the basis of these figures, there seems room for improvement in Great Britain.

Research Corporation Grants for Research

Some 2,500,000 dollars is being offered in grants to educational institutions by the Research Corporation of New York, a non-profit organization devoted to advancing research and technology by the use of revenues from inventions assigned to it by public-spirited inventors. Preference in making these grants will be given, other factors being equal, to smaller institutions and those of more limited financial resources for research. The five-year programme announced by Dr. Joseph W. Barker, acting president, who is dean of engineering at Columbia University and until recently was a special assistant to the Secretary of the U.S. Navy, provides for one to two hundred grants of 2,500–5,000 dollars a year to enable young men of science, engaged for the most part in war research in uniform or as civilians, to undertake at universities and colleges research of peacetime importance in pure science, especially chemistry, physics, mathematics and engineering. The first grants will be made shortly by a special committee of eminent men of science from industrial and university laboratories. Grants will be made to the institutions at which successful candidates will work and teach. The funds allotted will be available for the purchase of needed equipment and for the employment of assistants either as fellows or otherwise. Awards will be based primarily upon the demonstrated ability of the men who will conduct the researches and contribute to the teaching programme of the school. The grants are made possible by the fact that during the war years research programmes that would be normally supported by Research Corporation grants have been laid aside in order to free men and facilities for war research. The Research Corporation was begun in 1912 with the gift, through Dr. F. G. Cottrell, of patent rights on electrical precipitation, which is used for removing dust, fume and mists from industrial gases and from the atmosphere. From revenues derived from these and other patents it has made grants of 1,279,637 dollars in past years to fifty-two institutions. In recent years the Corporation has served universities by administering inventions that may in their laboratories. Correspondence in con- on with the grants should be sent to Dr. Robert R. ams, Research Corporation, 405 Lexington ue, New York 17, N.Y.

ilization of Syringes

E difficulty of sterilizing syringes satisfactorily been the subject of much recent research. A ing article in the *Lancet* (111, July 28, 1945) isses this problem, the importance of which is hasized by the publication, in the same issue 106), by E. M. Darmady and C. Hardwick, of ccount of hepatitis in ten subjects which followed administration, by means of syringes, of pentothal penicillin. These authors discuss the difficulties roving the possibility of the transmission by nges of the small amounts of blood containing cterogenic principle which are required to pro- hepatitis. The icterogenic principle involved hese authors say, so heat-resistant that ordinary hods of sterilization of syringes do not destroy it. longed heat is necessary for this. The use of lles alone for the withdrawal of blood for lab- ory purposes would also prevent the contamina- of whole syringes. The discussion of the same lem in a memorandum issued by medical officers he Ministry of Health, recorded in the same issue he *Lancet* (p. 116), comes to the conclusion that sion of existing injection techniques is required, that hepatitis following the injection of arsphen- ne, gold and other substances is an expression of ologous serum jaundice communicated by traces blood transferred from subject to subject on nges and needles. It is, of course, easy to over- mate the dangers which may result from existing hods of sterilization of syringes. Millions of ctions must be done every year without untoward lts. But the evidence recorded here emphasizes importance of the report of the committee ointed by the Medical Research Council (M.R.C. r Mem. No. 15, H.M. Stationery Office, 1945, 4*d.*) onsider the sterilization of syringes. This report ld interest the experimental worker as well as the ical man, for, in certain kinds of experimental k, the results may be seriously affected by in- quate attention to the cleaning of syringes and lles.

icity of D.D.T. to the Housefly

URING the War the importance of the compound lly referred to as D.D.T. as an insecticide has demonstrated. In the *Bulletin of Entomological arch* (**36**, Pt. 2; Sept. 1945), E. A. Parkin and A. Green, of the Pest Infestation Laboratory at gh, describe experiments in testing the efficacy controlling the housefly (*Musca domestica*) by ns of D.D.T. They found that when applied as pray containing 0·1 per cent w./v. or more of .T. in kerosene it is very toxic to the insect in stion. At 1 per cent strength D.D.T. gives an ctive spray for practical use but at lower con- rations its action is too slow. Its advantages fly spray are that it can be prepared synthetically; almost odourless; it will not stain fabrics, etc.; ppears to have no marked irritant effect upon operators up to 2 per cent strength; it is ex- nely lethal to flies both in solution and in the d form after deposition on walls, etc., from volatile ents. Its main disadvantage is its slow rate of on on flies unless used at a concentration of at least 1 per cent w./v.; but, even at this strength, affected flies produce an unwelcome buzzing, for at least an hour prior to the wing muscles becoming paralysed. The slow action of this compound can be overcome by the admixture with D.D.T. of a small amount of pyrethrins which has a very rapid paralytic effect. It would appear that the two constituents act independently, the rapid effect of the pyrethrins keeping the flies immobile until the slow lethal action of the D.D.T. has had time to come into effect.

British Rheologists' Club

THE fifth annual general meeting of the British Rheologists' Club was held at the Engineers' Club, Manchester, on October 5. Dr. G. W. Scott Blair, the retiring honorary secretary, reported on the activity of the Club during the year 1944–45, and stated that membership had reached the three hundred mark. The Club had held four general meetings, and two bulletins of information, abstracts, etc., had been issued. Close contact had been maintained with the Society of Rheology (United States), and contacts had begun with rheologists in the U.S.S.R., France and other countries. The Proceedings of the Oxford Conference were nearly ready and would be published in book form. Prof. E. N. da C. Andrade was re-elected president for the ensuing year. Dr. E. W. J. Mardles of the Royal Aircraft Establishment, Farnborough, Hants, was elected secretary; a vote of thanks was moved from the chair to Dr. Scott Blair, who had been secretary of the Club since its inception in 1940. The meeting was followed by a joint discussion with the Manchester Section of the Oil and Colour Chemists' Association on the general rheological properties of suspensions.

Announcements

DR. H. R. HULME, sometime a chief assistant at the Royal Observatory and recently director of naval operational research at the Admiralty, has been appointed scientific adviser to the Air Ministry.

AT a meeting of the Council of the University of Sheffield held on December 14, the following appointments were announced: Mr. P. C. Sylvester-Bradley to be assistant lecturer in geology, and Dr. H. McIlwaine to be lecturer in biochemistry. Dr. A. Elliott, lecturer in physics, Dr. J. C. Speakman, lecturer in chemistry, and Mr. F. G. Hannell, lecturer in geography, have resigned.

THE All-Union Scientific Research Institute of Plant Industry of the U.S.S.R., made famous under the directorship of N. I. Vavilov, has returned to Leningrad from evacuation, and has begun to set its collections in order and to re-establish its exchanges of seeds and literature. None of the priceless collection of seeds has been lost. During the siege the Institute was guarded by five members of the staff who remained in Leningrad. This corrects the statement in the obituary article of Vavilov (*Nature*, **156**, 622; 1945) that "the residue of his collections was eaten by the famished people". Altogether about thirty members of the staff were killed or died of starvation during the siege. The director, Academician Eichwald, and the librarian, Mrs. Heintz, are anxious to resume exchanges. The address of the Institute is Ulitsa Gertsena 44, Leningrad.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Freedom for Scientific Research

In these days of 'planning' there seems a general desire by many, little qualified, to put science in its place.

The horrible threat that science was no longer to be international has been protested against, very rightly, by all that is best in the United States, Britain and elsewhere.

The idea that there should be two classes of men of science, one knowing government secrets and research work, and those outside the sacred fold, was, and is, a very shocking proposal. Now, I notice a school of thought that wants to plan fundamental research, forgetting that once you instruct anyone as to what they are to study, you are *ipso facto* imposing *ad hoc* research upon them.

I think it was the great J. J. Thomson who once said after the Boer War that if you had planned and organized science to explore the best way of finding bullets located in the human body, certainly probing might have become an art and the human body a pin-cushion, but not that way would there have been brought about X-rays. Mr. Herbert Morrison, I was delighted to see, speaking at the British Association, appreciated the point, and said you could not dragoon men of science relative to fundamental research. Well spoken.

Much remains to be done in planned *ad hoc* research by capable men to exploit (unpleasant word) for the good of all the discoveries of the laboratory. Here much can and should be done, for it is only by producing the most up-to-date and advanced design and technique that we can hope to export our goods in a world where every country is seeking to become industrialized.

We must appreciate that the pure scientist is a creative artist. No one must boss him. No one drive him. We are lucky in the production of these great men. Certainly arrange that their lives be free of monetary worries, but let us remember that their life interest and pleasure is research, and leave them to carry on undisturbed by the stormy blasts and distractions of a world licking its wounds and quarrelsome after a protracted fight. Do not of all things plan their lives. Some will produce future miracles no doubt, but most perhaps may not be so lucky. That should not worry us; our duty is to have given them the chance, and although many of their names may not be handed down to the future praised by all, yet they will have done good and noble work, for which we should all be no less grateful.

Brabazon of Tara.

70 Pall Mall,
London, S.W.1.
Dec. 10.

Lognormal Distributions

In pointing the way towards easier manipulation of non-normal distributions, Prof. J. H. Gaddum's recent article[1] should act as a heartening stimulus to geologists. Sedimentary petrologists in particular will welcome it, for the efficacy of Prof. Gaddum's main theme is already established in certain
of their domain.

We are indebted chiefly to the American scl
Up to the present, most attention has been pai
the normalization of size distributions. The
and 'zeta' scales of Krumbein[2,3,4,5] are illustra
in this connexion, representing logarithmic tr
formations of the Wentworth and Atterberg
metric grade-scales. The transformations are car
out by substituting logarithms of the grade-s
limits for the appropriate diameter-values (ξ n
through

$$\varphi = -\log_2 \xi, \text{ and } \zeta = 0{\cdot}30\dot{1} - \log_{10} \xi.$$

They yield, of course, scales having arithmetic
tervals; hence the 'normal phi curve' (ref. 5, p. 2
and the direct application of conventional statis
to problems of sedimentary distribution. But
needs to recall that moment-analysis shows
sediments yield many local size-distributions w
are not rendered significantly (or even approximat
normal through the simpler logarithmic transfor
tions. The indiscriminate use of a particular func
is consequently to be deprecated, and a prelimin
attempt should always be made to discover that
which will either give the 'perfect' measure direc
or at least ensure the greatest chance of obtainin
Should such treatment prove vain, then reco
must be had to 'post-mortem' search (often
simpler of the two) succeeded by individual tr
formation of the variates. It must not be forgot
too, that the skewness and kurtosis of certain s
mentary variables (such as particle size measu
in terms of diameter) probably have consider
geological significance, and must not be lost
sight.

Distributions of sedimentary composition may
approached in the same way. Within geologic
'synchronous' horizons, the areal variation may
considerable (for example, up to 500 per cent
700 sq. miles in certain Lower Cretaceous rocks).
underlying variates (specific and varietal proportio
however, are seldom lognormal. A contributory ca
may be the complex relation that seems to e
between the compositional standard deviation
and the compositional mean (ρ_m). For actively s
ing, eroding or aggrading currents (providing
mean patchiness they impose is not widely differ
from ρ_m) this may be of the form

$$\sigma_h^2 = \rho_m^2 \left(J + \frac{1 - 2\rho_m}{L\rho_m^2} S\right) + \sigma_r^2,$$

where S is variable and related to the numbers
particles removed and added locally, σ_r is the rand
deviation and J and L are horizonal constants for
allogenic minerals[6]. If experiment should conf
this, then a general transformative panacea app
priate to each horizon may be proved to exist.
the other hand, a few mineral species and variet
do occasionally yield to transformations of the t
$X = \log(x_0 - x)$. (This is inevitably the prem
alternative to $X = \log x$ for those minerals wh
are liable to absent themselves locally.)

Neither can Prof. Gaddum's pertinent rema
concerning variance be overstressed to the geolog
No assumption of homogeneity of the variance wit
sedimentary universes should be lightly made,
be based where possible on rigorous test[7,8]. This
particularly urgent during detailed studies of 'patc
ness' by the analysis of variance when differences
locality are used as differences of 'treatment'. T

mentary petrologist, confronted in his quarry the solitary pebble embedded in fine silt, or rare particle locally so abundant, will most tily concur in Prof. Gaddum's advocacy of the its of the geometric mean.

PERCIVAL ALLEN.

epartment of Geology,
niversity of Reading.
Nov. 5.

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ure, **156**, 463 (1945).
Sed. Petrol., **4**, 65 (1934).
Sed. Petrol., **6**, 35 (1936).
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nual of Sedimentary Petrography" (New York, 1938).
Sed. Petrol., in the press.
tlett, M. S., *Proc. Roy. Soc.*, A, **160**, 268 (1937).
tlett, M. S., *J. Roy. Statist. Soc.*, Suppl., **4**, 158 (1937).

ROF. J. H. GADDUM has dealt[1] comprehensively ı the subject of logarithmic transformations, uding $X = \log (x + 1)$. The use of this trans- nation was first advocated by Williams[2] on the ınds that it approximated to the logarithmic ısformation for large values of x, and avoided the iculty of a non-finite value of X when x was zero ; this argument is rather arbitrary, since the same ght be said of any function of the form, $\log (kx+1)$. o, the existence of zeros implies usually that many the values of x will be small and lie in the range ere $\log (x + 1)$ behaves like a square-root trans- mation. Consequently, some further investigation the properties of this function seems to be called

Since there are several instances[3,4] where a good rection for discontinuity has been found by add- $\frac{1}{2}$ to the variate, it appears possible that the nsformation, $X = \log (2x + 1)$, would have the vantages of $X = \log (x + 1)$ and would also cor- t the ordinary logarithmic transformation for dis- ıtinuity.

Two trials have recently been carried out to in- stigate empirically the properties of these two nsformations. Each was concerned with the mbers of fruits on apple trees. In the first there re four randomized blocks of seven treatments with en trees to a plot. It was thus possible to compute variance within plots with 24 degrees of freedom each treatment, and to compare the seven vari- ces thus obtained by evaluating the ratio of their ometric and arithmetic means. This quantity, own as L_1, has been tabulated by Nayer[5]. Using $\sqrt{x + \frac{1}{2}}$ transformation, L_1 was 0·863 ; for $(x + 1)$ it was 0·980 ; and for $\log (2x + 1)$ it s 0·982. The first of these values indicates a nificant departure ($P < 0{\cdot}01$) from uniformity in variances; but it will be seen that both the arithmic transformations were successful in equal- ng them. The mean numbers of fruits per tree the different treatments varied from 1·3 to 10·0, the values of the variate largely lay in the range ere discontinuity is serious and where $\log (x + 1)$ ost closely approximates to $\frac{1}{3}\sqrt{x}$. In the second al there were 64 pairs of trees of which 32 had en starved of potash while the rest had received equate fertilizer, the treatment means being re- ectively 8·3 and 12·5 fruits per tree and the ranges thin which the data lay being respectively 0–35 d 0–67 fruits. Variances with 32 degrees of freedom re worked out between trees within pairs within treatments. Using the transformations $\sqrt{x}$, $\sqrt{x + \frac{1}{2}}$, $\log (x + 1)$ and $\log (2x + 1)$, the values of L_1 were 0·968, 0·952, 0·9987 and 0·9998 respectively. Of these the second approaches the 5 per cent significance point, while the last two represent unusually good agreement between the variances. Indeed, such good agreement must be considered as partly fortuitous.

It would be rash to base much on the results of two small trials. However, there is reason to think that the transformation, $X = \log (x + 1)$, may be useful in dealing with small integral values despite the arbitrary element in its original selection, and despite its approximating sometimes to a square root and sometimes to a logarithmic transformation. It seems, also, that $X = \log (2x + 1)$ has at least an equal claim to be considered when such data are dealt with. It is to be hoped that this matter will engage the attention of some mathematical statistician, for it has obvious importance in the interpretation of a large class of data.

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East Malling Research Station,
East Malling,
Maidstone,
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[1] *Nature*, **156**, 463 (1945).
[2] Williams, C. B., *Ann. Appl. Biol.*, **24**, 404 (1937).
[3] Yates, F., *J. Roy. Statist. Soc.*, Suppl., **1**, 217 (1934).
[4] Bartlett, M. S., *J. Roy. Statist. Soc.*, Suppl., **3**, 68 (1936).
[5] Nayer, P. P. N., *Statist. Res. Mem.*, **1**, 38 (1936).

DR. ALLEN'S letter is welcome because it emphasizes the fact that no simple transformation can act as a panacea. The choice of the appropriate technique for any given problem must always be based, if possible, on direct evidence of its suitability. Another type of distribution has been discovered by Bagnold[1], who studied the distributions of the sizes of particles of sand deposited by wind. They were not lognormal, but when the logarithm of the diameter was plotted against the logarithm of the frequency, the observations were closely fitted by two straight lines. This fact presumably depends on the physical factors governing the deposition of particles from moving air, and may have many applications in geology. Such distributions can be normalized, but no simple general formula can be given since the slopes of the two lines may vary independently, and it is doubtful whether normalization would serve any good purpose. The logarithmic transformation is a useful tool; but, as Dr. Allen has emphasized, it must be used with care.

I should be glad to hear of more examples of lognormal distributions.

J. H. GADDUM.

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[1] Bagnold, R. A., "The Physics of Blown Sand and Desert Dunes" (London: Methuen, 1941).

Kinematical Relativity

MY attention has been directed to Prof. H. Dingle's recent letter in *Nature*[1]. His supposed refutation of kinematical relativity is on a par with Dr. Samuel Johnson's refutation of metaphysics ; my failure to reply to him directly is due to my reluctance to engage in such trivialities. I have already given him all the answer he needs by referring him to my mathematical papers, where the case of the collision of equivalent particle-observers is fully dealt with. You cannot wantonly re-graduate any casual clock and expect to secure a consistent physics. Kinematical relativity does not do so. In kinematical relativity it is shown that for consistent time-keeping to be possible, the various particle-observers whose temporal experiences constitute clocks must be members of *equivalences*. Regraduation is applied only to such equivalences; and it was shown by Whitrow and myself[2] that if two members of an equivalence ever coincide, then *all members coincide at the same event*. This technical point is well known to all who have studied time-keeping in relation to equivalences; it is fundamental, for example, in some recent unpublished work by A. G. Walker. In its application, it means that in a contracting universe of time-keepers, there would be a singularity which would be the counterpart of 'creation' in an expanding universe. Prof. Dingle is concerned with the timing of 'subsequent events'; there would be no subsequent events—Prof. Dingle would not survive the catastrophe—just as in an expanding universe there are no events anterior to 'creation'. There are other objections to a contracting universe, but the 'absurdity' which preoccupies Prof. Dingle is a monster of his own construction which simply adds point to the absurdity of a contracting universe. As the universe is observed to be expanding, Prof. Dingle's difficulties never arise.

Prof. Dingle appears to resent my referring him to my published papers. I did so because I resent being continually required to re-traverse in the looseness of verbal statement ground carefully covered, with all due reservations, in the technical papers. Prof. Dingle has recently suggested that kinematic relativity cannot account for the red-shift in the spectra of the galaxies, whereas kinematical relativity is essentially the exploration of the properties of a cloud of mutually receding particles. If Prof. Dingle does not like clock-regraduation, let him content himself with the t-scale, which describes a consistent physics as it stands; only, he will have difficulty with reconciling its results with Newtonian mechanics unless he faces the fact that Newtonian mechanics employs the τ-scale, not the t-scale.

E. A. MILNE.

Wadham College,
Oxford. Oct. 15.

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[1] *Nature*, **156**, 389 (1945).
[2] *Z. Astrophys.*, **15**, 277 (1938).

PROF. MILNE states that I have misapplied his principle of clock-regraduation. If so, Prof. Haldane has made the same mistake. The lamp-post example was his, and his letter[1] expressed his belief that Milne's transformation was applicable to it. The only difference between us was that he trusted that Milne could make his transformation "lead to the same predictions of observable events"—he stated that this could be done—and I did not. Now Prof. Milne fails him by denying the obligation.

Nevertheless, Haldane and I are right. In Milne's accounts of his theory (in "Relativity, Gravitation and World-Structure", for example), the right to regraduate clocks is first claimed on *a priori* grounds independent of applications. Only afterwards are equivalences defined as consisting of observers who impose a particular voluntary restriction on this general right. Now Prof. Milne wants to deny the right to all but these observers. On what grou Indeed, for that matter, are not the nose and la post members of an equivalence? They can fulfi conditions, and no minimum number of *a* observers is prescribed. Prof. Milne can, of co claim that he can make what arbitrary distinct he likes in an ideal hypothesis: in that ca challenge his right to call a romance a scier theory. If, on the other hand, he says that system of nebulæ provides an application for theory, then I ask why the student of nebulæ regraduate his clock, but not the student of la posts or meteorites.

HERBERT DINGL

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[1] *Nature*, **156**, 266 (1945).

Clock-Regraduations and Relativistic Cosmology

PROF. E. A. MILNE has severely criticized rela istic cosmology for several reasons, one being t this theory is restricted to a definite time-sc whereas his own theory admits of an infinite num of time-scales. Milne's construction of an 'equivale is invariant over a clock-regraduation, that is change from one time-scale to another.

In 1943[1], I suggested that the true analogue clock-regraduations in relativity theory was to found in Weyl's transformation of gauge. For metrics of relativistic cosmology, this reduces t change of the function γ in the line-element,

$$ds^2 = \gamma(r,t) \,.\, (dt^2 - dx^2 - dy^2 - dz^2).$$

It follows as a corollary to Infeld's[2] remarks th with this interpretation, Maxwell's equations a Dirac's equations are invariant over clock-regrad tions, while the relations of spherical symmetry a homogeneity are also preserved.

These remarks seem to dispose of one, at least, Milne's main criticisms of relativistic cosmology.

T. J. WILLMORE

Balloon Development Establishment,
Cardington, Bedford.
Aug. 18.

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[1] Willmore, T. J., Ph.D. Thesis (London, 1943).
[2] Infeld, L., *Nature*, **156**, 112 (1945).

Adsorption Isotherms from Chromatographic Measurements

DE VAULT[1] has directed attention to the possibil of obtaining the adsorption isotherm of single solu from chromatographic results of the 'diffuse' boun ary, suggesting a differential equation for evaluati the measurements. A more useful equation can obtained by integration of the equation

$$v/x - \alpha = dq/dc,$$

where α and q are the pore space and the amou adsorbed per gram of adsorbent. After developi with a given amount of pure solvent v, the amou of solute μ remaining in the column between t tail end of the chromatogram and the point $\bar{x}$ wh the concentration $\bar{c}$ exists is

$$[\mu]_{\bar{c}} = \int_{c=0}^{c=\bar{c}} (q + \alpha c)dx$$

$$= \Big[(q + \alpha c)x\Big]_{c=0}^{c=\bar{c}} - \int_0^{\bar{c}} \left(\frac{dq}{dc} + \alpha\right) x dc \quad . \quad (2b)$$

$$= \overline{qx} + \alpha\overline{cx} - v\bar{c} \quad . \quad . \quad . \quad . \quad . \quad (2c)$$

Thus we obtain for the amount adsorbed

$$\bar{q} = f_{(\bar{c})} = ([\mu]_{\bar{c}} + v\bar{c})/\bar{x} - \alpha\bar{c} \quad . \quad . \quad . \quad (3)$$

Since μ is obtained experimentally as the total subsequent eluate in grams when $\bar{x}$ represents the length of the column, the complete adsorption isotherm can be obtained from a single chromatographic experiment simply by measuring the concentrations of successive eluted fractions.

The same integration can be carried out for two (and more) solutes. The fundamental equations for the mixed band of varying concentration

$$v/x - \alpha = dq_1/dc_1 = dq_2/dc_2 \quad . \quad . \quad . \quad (4)$$

require that co-existing values of c_1 and c_2 are functions of each other only; so that

$$q_1 = f_{(c_1 c_2)} = \Phi_{1(c_1)} \quad . \quad . \quad . \quad . \quad (5a)$$

$$q_2 = g_{(\bar{c}_1 c_2)} = \Phi_{2(c_2)} \quad . \quad . \quad . \quad . \quad (5b)$$

This means that within the diffuse mixed band the two solutes behave individually like single solutes, having an adsorption isotherm which is modified by the presence of the other solute. They follow the equations:

$$v/x - \alpha = d\Phi_{1(c_1)}/dc_1 = d\Phi_{2(c_2)}/dc_2, \quad . \quad . \quad (6)$$

where the functions Φ_1 and Φ_2 depend on f and g, and also on the initial concentrations c_1^0 and c_2^0. This makes it possible to integrate equation 6 in the same way as equation 1, resulting in:

$$\bar{q}_1 = f_{(\bar{c}_1\bar{c}_2)} = ([\mu_1]_{\bar{c}_1\bar{c}_2} + v\,.\,\bar{c}_1)/\bar{x} - \alpha\bar{c}_1 \quad . \quad (7a)$$

$$\bar{q}_2 = g_{(\bar{c}_1\bar{c}_2)} = ([\mu_2]_{\bar{c}_1\bar{c}_2} + v\,.\,\bar{c}_2)/\bar{x} - \alpha\bar{c}_2 \quad . \quad (7b)$$

The presence of the tail band of pure component I seems to complicate the procedure, but this is actually not so; it can be shown that the total amount contained in the pure tail band is identical with what it would contain if equation 6 were continued beyond the point x_0, where solute II becomes zero. Thus μ_1 actually represents the total amount of solute I—both pure and mixed—which remains in the column when the eluate reaches the concentration $\bar{c}_1$.

This method of determining the adsorption isotherms of binary mixtures was found to give accurate and reproducible results, provided that the chromatographic separation was carried out with negligible 'channelling' and sufficiently slowly, so as to reach local equilibrium between solution and adsorbent everywhere. Several elution experiments using widely different ratios of c_1^0/c_2^0 are required to cover the whole range of a binary adsorption isotherm. Details and experiments will be published in due course.

Incidentally, if equation 7*a* is applied to the state of complete chromatographic separation of two solutes (by making $\mu_1 = m_1$, that is, the total solute I, $c_1 = c_1' = [c_1]_{c_2=0}$ and $x = x_0 = v\,.\,[\alpha + dg_{(c_1 0)}/dc_2]^{-1}$), this leads to the volume of pure solvent V required for complete separation:

$$V = m_1 \,.\, \frac{\alpha + g'_{(c_1'0)}}{f_{(c_1'0)} - c_1' \,.\, g'_{(c_1'0)}}, \quad . \quad . \quad (8)$$

which is in agreement with equation 6 of an earlier communication[2] where α had been neglected.

E. GLÜCKAUF.

University Science Laboratories,
Durham. Sept. 7.

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[1] de Vault, D., *J. Amer. Chem. Soc.*, **65**, 532 (1943).

[2] Glückauf, E., *Nature*, **156**, 205 (1945).

Efficacy of D.D.T. in Soap

ONE of the remarkable features of the successful use of D.D.T.-impregnated clothing against the louse is the prolonged insecticidal effect of the clothing after several launderings, which would appear to indicate a strong absorption of the compound on the textile fibres. It occurred to us that animal hair might behave in the same way, and that useful results might be obtained in veterinary practice by the simple expedient of incorporating D.D.T. in soap[1].

Rather more than a year ago, we began experiments using varying proportions of the insecticide milled with household soap, and through the kindness of several dog owners and veterinary surgeons we were enabled to arrange practical trials. Twelve dogs were treated, including spaniels, sheepdogs and other long-haired breeds, having infestations either of the dog flea, *Ctenocephalus canis*, or the dog louse, *Trichodectes canis*, varying from slight to heavy. The animals were washed with the soap and warm water for 10–15 minutes, then rinsed down and rubbed dry in the usual manner. All fully grown parasites on the dogs were seen to be killed by this treatment. Seven of the dogs were kept under observation for a further three months, during which period they were freely exposed to re-infestation. The first sign of this appeared nine weeks later, and was limited to one animal, the others remaining free from re-infestation for the duration of the trials. In two instances eggs of the insects were known to be present, but these failed to hatch during the normal period. It therefore seems that a considerable degree of immunity from such parasites can be conferred upon animals by washing with D.D.T. soap, and this should be of importance not only to dog owners, but also to farmers and animal breeders in general.

With the view of estimating the amount of insecticide left on the hair, we analysed samples from treated and untreated animals by solvent extraction, and found that the percentage of hydrolysable chlorine in untreated hair was 0·002 per cent, whereas treated samples ranged from 0·005 to 0·007 per cent, equivalent to 0·05–0·07 per cent of D.D.T. It is surprising that these minute amounts of D.D.T. should give such a lasting effect. In the case of clothing impregnated with D.D.T., a concentration of only 0·01 per cent of the compound in the impregnation solution gave surfaces displaying noticeable insecticidal properties against the louse[2]. It would appear, therefore, that there is a similar absorption on the surface of the hair which prevents the D.D.T. from being washed off with the soap medium. Experiments to examine the mechanism further are in hand.

G. A. CAMPBELL.

The Geigy Co., Ltd.,
Manchester, 3.

F. C. HYMAS.

Spratt's Patent, Ltd.,
London, E.14.

T. F. WEST.

Stafford Allen and Sons, Ltd.,
London, N.1.
Aug. 29.

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[1] Geigy Company, Ltd., B.P. Application 1944.

[2] Domenjoz, R., *Schweiz. med. Wchschr.*, **74**, 954 (1944).

Differentiation of Nuclear Substances

One of the most used reactions of the clinical-chemical laboratory is the sedimentation reaction of the erythrocytes. It has been shown that sedimentation is hastened if, in consequence of physiopathological occurrences in the organism, the protein fractions of high molecular weight (fibrinogen, globulins) have increased[1].

We were able to demonstrate by means of some typical reactions[2] that the sedimentation reaction is chiefly of an unspecific nature and occurs with polysaccharides as well as with plasma proteins. We have succeeded, by fractional precipitation of the spherical colloid glycogen with methanol, in separating polymers of high molecular weight with diameters of approximately 100 glucose molecules from polymers with diameters in cross-section about ten times smaller. These different fractions of polymers produce accelerations of sedimentation which vary in accordance with their average particle size. This interdependence was shown with still greater accuracy with the rod-shaped molecules of apple pectin[3]. These long, partly methylated chain molecules of galacturonic acid are easily disaggregated by neutral hydrolysis. In proportion to this hydrolysis it is possible to measure the diminution of viscosity, the scattered light (Rayleigh), as well as the effect on acceleration of sedimentation.

After these preliminary experiments the following tests were made and compared: adenylic acid from yeast (mononucleotid, mol. weight 347), yeast nucleic acid (tetranucleotid, $C_{38}H_{49}O_{29}N_{15}P_4$, mol. weight 1303) and thymonucleic acid kindly provided by Prof. Rud. Signer (mol. weight 600,000–1,000,000)[4]. The last-named substance accelerated the sedimentation of erythrocytes even in a concentration of 6 mgm. per cent in measurable extent. On the other hand, the yeast nucleic acids produced no effect even in a concentration of 400 mgm. per cent. A provisional review of these effects follows.

From fresh human blood the erythrocytes are washed three times with saline on the centrifuge, in order to attain a suspension of 100 per cent in the end. 5 mgm. of the nucleic acids are first dissolved in 0·5 c.c. of homologous serum and then diluted with 0·5 c.c. saline. Then 5 mgm. of glycogen, gelatine and pectin are first dissolved in 0·5 c.c. saline and then diluted with 0·5 c.c. serum. Now we mix carefully 0·3 c.c. of these solutions with 1·2 c.c. of the 100 per cent erythrocyte suspension. With this the concentration of the nucleic acids and the polysaccharides is brought to 100 mgm. per cent. Five minutes later the suspensions are drawn up in original Westergren pipettes, and the sedimentation read off in mm. in corresponding periods:

Additions to erythrocytes	Sedimentation (min.)						20 hours
	10	20	40	60	90	120	
Serum and saline only	—	—	—	0·5	1	1·5	16
Adenylic acid from yeast	—	—	—	0·5	1	1·5	16
Nucleic acid from yeast	—	—	—	0·5	1	1·5	18
Thymonucleic acid	1·5	9	23	61	83	96	115
Glycogen	—	—	—	0·5	1	1·5	18
Gelatine	—	—	1	2	4	6	35
Pectin	2	26	89	116	119	120	123

The superior effect of the high molecular thread-like molecules of the sodium salt of thymonucleic acid (desoxyribonucleic) compared with the yeast nucleic acids (ribonucleic) is evident. Since both types of nucleic acids are polymers of mononucleotides it follows that the new way of differentiating between them depends on their particle-size rather than on the different constitution of their ribose component. The exact interdependence of the molecular weight and the acceleration of the sedimentation of the erythrocytes could be proved with a sequence of homologous polymers like polystyrol for example. If such synthetic polymers were to be tried, one would have to ascertain that they do not possess hæmolytic properties. The substances mentioned above have none, and moreover the serum makes an excellent buffer.

Ch. Wunderly.

University Medical Clinic,
Zurich. July 20.

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[1] Gordon and Wardley, *Biochem. J.*, **37**, 393 (1943).

[2] Wunderly and Wuhrmann, *Schweiz. med. Wchschr.*, **74**, 185 (1944).

[3] Wunderly, *Viert. Jahrsschr. Naturf. Ges. Zürich*, **89**, 170 (1944). *Helv. chim. Acta*, **26**, 755 (1943).

[4] Signer, Caspersson and Hammarsten, *Nature*, **141**, 122 (1938).

Influence of Blood Pressure and Blood Flow on the Activity of the Respiratory, Vasomotor and Cardio-Regulatory Centres

The classical opinion is that changes in the central blood flow and blood pressure affect and regulate in a direct central manner the activities of the respiratory and cardio-vascular centres: decrease of central blood pressure or blood flow was considered to stimulate directly the respiratory and vasomotor centres and to inhibit directly the tone of the vagal cardio-inhibitory centre; increase of central pressure or flow was considered to induce directly the opposite central reactions. Although numerous experiments performed by several different methods had shown[1] that blood pressure and blood flow changes occurring in physiological and physio-pathological conditions affect the activities of the respiratory and cardio-vascular centres not through a *direct* central action but only *reflexly* by way of the presso-receptor nerves of the aortic and carotid sinus areas, the classical theory of direct central regulation is still supported, particularly as regards the physiological control of the respiratory centre[2]. As this point is of fundamental theoretical importance, I have investigated the problem.

Experiments were performed on dogs anæsthetized with chloralosane; systemic arterial blood pressure, heart frequency and respiratory rate, amplitude and volume were registered. The experimental results may be summarized as follows.

(*a*) Occlusion or desocclusion of the efferent arteries (internal and external carotid and occipital arteries) of the common carotid arteries do not affect the activity of the respiratory and cardio-vascular centres.

(*b*) Occlusion or desocclusion of both vertebral arteries, alone or simultaneously with the efferent arteries of the common carotid arteries, also do not affect the activity of the respiratory and cardio-vascular centres, although the occlusion and release of these very important and main cerebral arteries induce very marked changes in the central blood pressure and blood supply.

(*c*) Decrease up to about 75 per cent of the normal blood supply or blood pressure to the isolated and perfused cerebral circulation does not stimulate directly the respiratory, vasomotor and cardio-regulatory centres.

(*d*) The isolated cephalic circulation being perfused means of the two common carotid arteries only, clusion of the common carotid with normal in- rvated carotid sinus induces a stimulation of the spiratory centre, while the occlusion of the common rotid with denervated carotid sinus does not stimu- te the respiratory centre.

(*e*) Decrease of blood pressure in the circulatory olated but normally innervated aortic or carotid nus presso-sensitive areas induces, as shown reviously[1], a reflex stimulation of the activity of the spiratory and vasomotor centres and a reflex in- bition of the vagal cardio-inhibitory centre; in- ease of blood pressure in the same presso-sensitive terial areas induces reflexly a respiratory inhibition, ecrease of general blood pressure and slowing of the eart.

These experimental results thus show conclusively at: (1) Changes of the central blood supply or blood ressure within physiological, but not to extreme hysio-pathological, limits do not affect directly but flexly the activity of the respiratory and cardio- ascular centres; (2) physiological or physio- athological variations of the arterial blood pressure ct reflexly, by means of the aortic and carotid sinus resso-receptors, on the activity of the respiratory nd cardio-vascular centres.

These experimental facts thus do not support the neory of the physiological regulation of the activity f the respiratory and cardio-vascular centres by neans of their own internal metabolic rate. Never- heless, as shown by previous experiments of our boratory[1-3], extreme pathological modifications of ne central blood supply may affect directly the espiratory and cardio-vascular centres; but these fluences have no practical importance for the *hysiological* control of respiration and the circulation. hese experimental facts also show once more that ypoxæmia does not stimulate the respiratory centre irectly, but reflexly by means of the chemoreceptors, nd are in favour of the probability of a specific unction of the carbon dioxide in respiratory control.

C. HEYMANS.

Department of Pharmacology,
University of Ghent. July 16.

Heymans, J. F., and Heymans, C., *Arch. intern. pharmacodyn.*, **32**, 9 (1926). Hering, H. E., "Die Karotissinusreflexe auf Herz und Gefässe" (Dresden und Leipzig, 1927). Heymans, C., *Amer. J. Physiol.*, **85**, 498 (1928). *Ergebn. Physiol.*, **28**, 244 (1929). "Le Sinus carotidien" (Paris, Presses Universitaires; London, Lewis, 1929). Heymans, C., and Bouckaert, J. J., *J. Physiol.*, **69**, 254 (1930). Heymans, C., Bouckaert, J. J., and Regniers, P., "Le Sinus carotidien et la zône homologue cardio-aortique" (Paris: Doin and Co., 1933.)

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Nowak, S. J. G., and Samaan, A., *Arch. Intern. pharmacodyn.*, **51**, 206 and 463 (1935). Heymans, C., Bouckaert, J. J., Jourdan, F., Nowak, S. J. G., and Farber, S., *Arch. Neurol. and Psych.*, **37**, 304 (1937). Marri, R., and Hauss, W., *Arch. intern. pharmacodyn.*, **63**, 469 (1939).

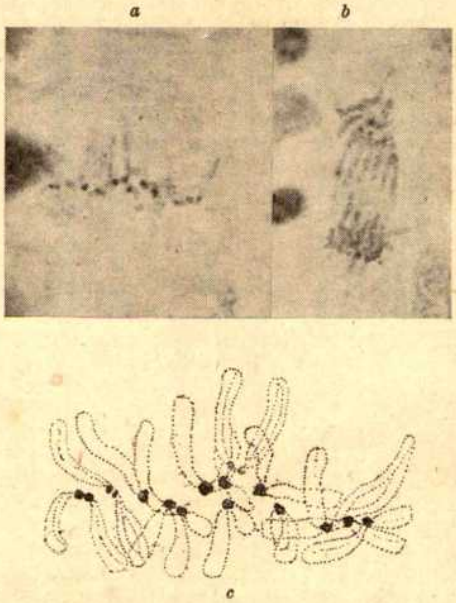
Cytological Reactions Induced by Inorganic Salt Solutions

AN investigation has been carried on for some time a this Laboratory into the immediate cytological ffect of salt solutions on root meristems of *Allium 'epa*. Salts, mostly nitrates, of some forty metals rere tested. A dilution series of 10–16 concentrations rere studied for each substance, covering the whole ange from total lethality down to such weak concentrations that no cytological effect could be detected. Fixations of root tips were made after 4 and 24 hours respectively. All slides were stained with crystal-violet.

A rather surprising result of these treatments was the very common occurrence of colchicine mitosis. Full and typical colchicine mitosis was met with in different concentrations of salt solutions of the following metals: lithium, beryllium, sodium, potassium, chromium, iron, cobalt, nickel, copper, arsenic, rubidium, yttrium, palladium, cadmium, barium, lanthanum, cerium, neodymium, erbium, gold, mercury, thallium, lead, bismuth and thorium. Almost all the substances tested showed at least some tendency to spindle disturbances such as are typical of incipient colchicine mitosis.

In many cases the activity threshold of colchicine mitosis was considerably lower than it is in colchicine, for example, in cupric nitrate, yttrium sulphate, lanthanum nitrate, auric chloride and lead nitrate, where it was situated at 0·000005–0·00005 mol., that is, at the degree of activity of acenaphthene. On surveying the whole material, a tendency of the threshold values to fall with increasing molecular weight was observed. In the fifth, sixth and seventh periods of the periodic system, all threshold values lie below 0·0005 mol., while in the second and third periods several thresholds lie as high as 0·05–0·2 mol. Especially such salts as are among the nutrients of plants have high threshold values (that is, low colchicine mitotic activity).

Several of the tested substances induced colchicine mitosis which in morphological details as well as in completeness was indistinguishable from the typical cochicine-induced mitosis. Such was the case, for example, with lead nitrate and potassium cyanide. Otherwise, the colchicine mitosis induced by salt solutions was found to show a greater variation in type than is found after treatment with organic substances. Thus, it was often incomplete: at several steps of the dilution scale it might occur intermingled



Allium Cepa, MITOSES OF THE ROOT MERISTEM, ROOTS TREATED FOR FOUR HOURS WITH 0·005 MOL. MERCURIC NITRATE; *a*, METAPHASE, × 1050; *b*, ANAPHASE, × 1050; *c*, CONTOUR DRAWING OF *a*, × 2100.

with normal mitoses. Other deviations from the normal course of colchicine mitosis, some of which have been described earlier from material treated with colchicine (Barber and Callan[1]), were: 'star-metaphase' (induced by, among other substances, lithium nitrate), 'ball-metaphase' (arsenious oxide), and 'bow-metaphase' with long arched chromosomes scattered over the cell (lanthanum and cerium nitrates). A peculiar type of mitosis, the mechanism of which may be quite unrelated to colchicine mitosis, was induced by nickel nitrate: the chromosomes behave as in colchicine mitosis, although a clearly visible spindle is present.

The colchicine-tumour reaction, which on treatment with organic substances usually accompanies the colchicine mitosis, is rarely present when inorganic salts are used for the induction of this form of mitosis. Nevertheless, there often occur characteristic growth disturbances: the roots become bent into hooks or even wound into spirals. This reaction may represent incomplete colchicine-tumour growth.

A reaction which is found only in exceptional cases after treatment with organic substances, but which was of rather general occurrence in the present experiments, is the induction of sticky chromosomes, manifested mainly by the formation of anaphase bridges. Pronounced stickiness was observed in the following treatments: lithium, beryllium, aluminium, titanium, chromium, iron, cobalt, nickel, copper, arsenic, yttrium, zirconium, molybdenum, palladium, cæsium, lanthanum, cerium, neodymium, erbium, tungsten, gold, mercury, thallium, bismuth, thorium and uranium.

Many of the salts tested caused deviations in the staining qualities of the chromosomes. Thus, during the contraction stages, the ability to take the stain was often decreased. At the same time the internal structure of the chromosomes was revealed more clearly than normally. At metaphase the chromatids were widely apart, although coiled around each other. Each chromatid was clearly divided, and the space between the two half-chromatids was sometimes so considerable that the phenomenon cannot be due to an optical error. The half-chromatids often formed a relational spiral of great clearness. After these observations, I am convinced that the metaphase and anaphase chromatids of *Allium* are really divided. Especially illuminative in this respect was treatment with sodium fluoride, sodium molybdate, sodium tungstate, auric chloride, mercuric chloride, and phosphate – sodium hydroxide buffers. Although this reaction is subvital or lethal, its significance for the interpretation of vital structures is indisputable.

In several of those treatments which brought about a tendency of the chromosomes to stain very faintly, it was observed that the heterochromatic regions still stood out deeply stained when all colour had left the rest of the chromosomes. In fact, some of the treatments allowed a differential staining of the heterochromatin at metaphase-anaphase. This condition was found after treatment with beryllium, sodium, titanium, cobalt, yttrium, antimony, cerium, gold, mercury and others. The most delicate differentiation between euchromatin and heterochromatin has so far been found after treatment with mercuric nitrate in concentrations just above the fixing threshold. It can be seen from the accompanying illustration that the 'body' of the chromosomes is very weakly stained, while small darkly stained portions are present, one on each side of the centromere of each chromosome. The greater part of the hete chromatin of this variety of *Allium Cepa* is localiz to the vicinity of the centromeres.

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[1] *Proc. Roy. Soc.*, B, **131** (1943).

Carboxylase and Carbonic Acid

It is generally understood that, in the action carboxylase on pyruvic acid or other allied keto aci carbon dioxide is directly split off. The followi experiments show that this is not so, but that ca bonic acid is first formed, the process contrasti with urease action in which carbon dioxide is direct produced in the splitting of urea. (This latter h been investigated by Roughton and Krebs[1] wi respect to the action of carbonic anhydrase, and t present study of carboxylase is suggested by the procedure.)

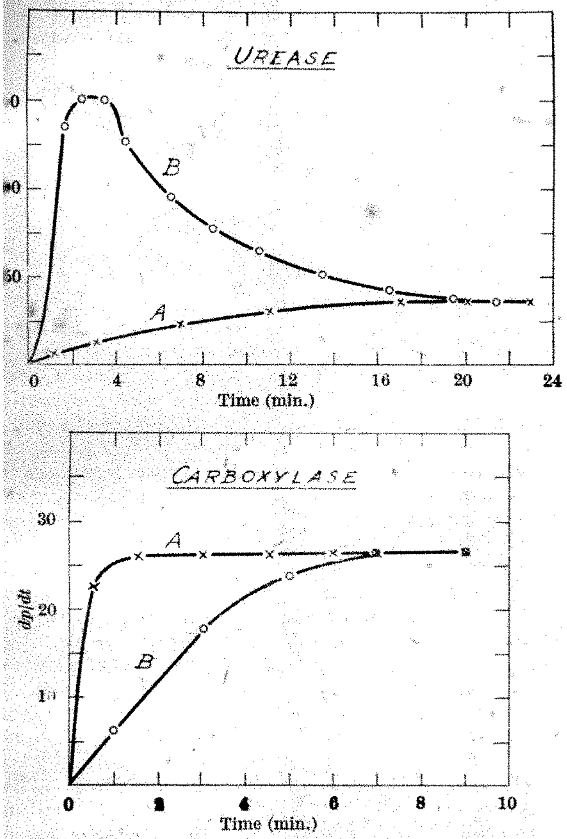
Sodium pyruvate was acted upon by a carboxyla solution in the presence of carbonic anhydrase pr vided by some laked rabbit blood, the whole at *p*H of 5·5. The course of the carbon dioxide evolutio was followed manometrically at 37° C. The exper ment was repeated with cyanide-treated blood (t inhibit the carbonic anhydrase), the *p*H of the mixtu being also 5·5. The conditions were as follows 1 c.c. of a yeast carboxylase preparation; 0·2 c. laked rabbit blood (1 in 12·5, with total carbo dioxide removed); 0·5 c.c. 20 per cent sodiu pyruvate, *p*H 5·5, added from side tube after equil bration. Similar experiments were carried out i which a urease preparation (buffered with phosphate was substituted for carboxylase and 5 per cent ure for sodium pyruvate, the *p*H of the whole being 6·8

In following the course of the evolution of carbo dioxide in the Warburg manometer, when the heigh of the fluid in the free limb of the manometer (th other being adjusted to the usual 150 mm. mark reached 300 mm., the vessel was immediately con nected momentarily with the atmosphere, and th levels rapidly adjusted to 150 mm., the experimen being then continued as before, and the pressur developed (in mm.) added to the previous sum. Thi procedure no doubt introduces some error, but of kind that has no significance for the question exam ined. From the data obtained the derivative dp/d was plotted against the time, with the results show in the accompanying graphs.

The urease curves show the same features as give by Roughton[1], namely, an initial rapid developmen of pressure contrasted with a smooth movemen towards a steady state in the presence of active car bonic anhydrase. The picture with carboxylase show essentially the opposite features, a rapid pressure development with active carbonic anhydrase, and comparatively slow rise of the curve in its absence

Theoretically, the picture with carboxylase (pro ducing carbonic acid) should not be the exact opposite of that with urease (producing carbon dioxide). With the former an over-fling of the upper curve would not be anticipated, and does not in fact occur.

The results show that carboxylase forms carbonic acid directly, and not free carbon dioxide. This con clusion is supported by the fact that the total carbon dioxide in the suspending fluid of a fermenting yeast mixture (with high proportion of yeast) is far highe



4, WITH *active* CARBONIC ANHYDRASE ; *B*, WITH *inactive* CARBONIC ANHYDRASE.

ian could be accounted for by free carbon dioxide r bicarbonate ions.

With the formation of carbonic acid by yeast arboxylase acting on pyruvic acid, it is very probable that it is also formed by similar ferments acting i animal tissues. This would affect rather much he detailed picture of carbon dioxide passage from issues to blood as hitherto given.

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July 28.

Roughton, F. J. W., *Physiol. Rev.*, **15**, 263 (1935).

Packing of Regular (Spherical) and Irregular Particles

MESSRS. BROWN AND HAWKSLEY have stated[1] that ie figures given by Mr. Ackermann[2] are apparently icorrect. As these figures were obtained by Mr. ckermann and myself working in conjunction, I iould like to state their exact meaning.

It is stated by Messrs. Brown and Hawksley that ie voidage is independent of the size of the container, rovided its shape and size are such that it will ontain an integral number of unit cells of the articular ordered arrangement. The figures given y Mr. Ackermann deal precisely with cases where ie container does *not* contain an integral number of units, but nevertheless the spheres are packed in an ordered fashion, and this is rhombohedral (each touching twelve), but not necessarily entirely so. He deals with cases where the diameter of the sphere is an aliquot part of the side of the cube, say $1/n$th. The spheres are then packed in alternate layers of n^2 and $(n-1)^2$ spheres, which in the case of a cube will normally leave a space at the top which cannot be utilized. In some cases, however, the space left is sufficient to convert an $(n-1)^2$ layer into an n^2 layer, and in this case the rhombohedral packing is not adhered to for this layer. The question that we were dealing with was the maximum number of spheres (the diameter being an aliquot part of the side) which could be packed into a cubical box by an ordered arrangement. I append a more detailed list of the figures obtained by Mr. Ackermann and myself.

Max. number of spheres in a row = n	Total number of spheres in box	Voidage
5	132	0·448
6	244	0·411
7	402	0·386
8	580	0·407
9	870	0·378
10	1,205	0·369
20	10,332	0·321
30	36,561	0·292
40	87,388	0·285
50	171,535	0·282
100	1,396,070	0·269

In the case where $n = 5, 7, 8, 10, 20$, it is found possible to change an $(n-1)^2$ layer into an n^2 layer.

The limiting voidage when the particles become infinitely small is $1 - \frac{\pi\sqrt{2}}{6} = 0{\cdot}2595$.

Since Messrs. Brown and Hawksley state that spheres when poured into a box take up a disordered arrangement with a voidage between 0·45 and 0·37, it will be seen from the above table that there is considerable advantage in the packing suggested. I do not think that any other ordered arrangement will give a greater number of spheres in a cubical box than is shown by the above figures.

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[1] *Nature*, **156**, 421 (1945).

[2] *Nature*, **155**, 82 (1945).

Mode of Entry of Contact Insecticides

Potts and Vanderplank[1] deduce a relation between the size of the pulvilli and the speed of action of contact insecticides. This would follow, as, to kill an insect, a lethal dose of the insecticide is required to be transferred to it. The larger the pulvilli, the larger the dose of insecticide the insect will collect when it alights on a treated surface. The speed of action of various modern synthetic insecticides, however, shows wide variation.

In some experiments with various types of animal lice (*Hœmatopinus suis*, *Trichodectes latus*, etc.), insecticidal wax sticks were made up containing 10 per cent of insecticide in a mixture of beeswax, paraffin wax and soft white paraffin. By wiping pieces of khaki serge very lightly with the sticks, a thin film of the material was transferred to the fibres of the serge in the form of fine sheaths of the waxy compound around the individual fibres. The pieces of serge were then fastened over the top of glass jars and belled inwards. The insects were introduced and prevented from straying by pieces of transparent cellulose fastened over the mouth of the jar. Lice came into contact with the insecticidal wax through the tarsal claws hooking around the sheathed fibres. When *n*-carbitol thiocyanate was used, the lice were dead in six minutes, whereas with D.D.T. the lice were not dead until the lapse of 120 minutes.

In these experiments, contact between the insects and the insecticides was almost entirely through the medium of the tarsi; and as, in these insects, the pulvillus is but little developed, it is unlikely that the relative size of the pulvillus has any special significance except as mentioned above.

N. E. HICKIN.

"Plummers",
Bletchingley,
Nr. Redhill, Surrey.
Aug. 20.

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[1] *Nature*, **156**, 112 (1945).

Ergot on *Pennisetum Hohenackeri* Hochst.

Pennisetum Hohenackeri Hochst. (*P. alopecuros* Nees) is a densely tufted perennial grass thriving in the clayey moist situations. The occurrence of sphacelial and sclerotial stages of a *Claviceps* on this host was first recorded by Ajrekar[1] in the course of his studies on the sugary disease of jowar in India caused by *Sphacelia Sorghi* McRae. In their studies on the ergot in South India, Thomas *et al.*[2] have given measurements of the spores of the *Sphacelia* and of the sclerotia. The honey dew forms a brownish viscid crust on the infected spikelets, embedding numerous spores. The spores are hyaline, thin-walled, 17–24 × 3–7 μ.

The ergot and sphacelial stages on *Pennisetum Hohenackeri* were collected round about Bangalore during the months of February and March. The collection of the sclerotial stages is rendered difficult at later periods on account of their dispersal by wind in the same manner as normal seeds. The persistent bristly glumes help in the process of dispersal. The identity of the *Claviceps* species has so far remained obscure on account of the lack of germination stages.

For germination, well-developed mature sclerotia were taken after dissecting out the enveloping glumes. These were wrapped up in a wire gauze and buried in dry soil placed in a pot in the greenhouse. Care was taken to prevent any extraneous moisture from soaking into the pot. The sclerotia were taken out after a month, treated with 0·5 per cent solution of potassium permanganate, washed in water and placed buried in sterilized moist sand in petri dishes. The germination of sclerotia was noticed after 20–30 days, the first indication being the rupture of the cortex of the sclerotium and the extrusion of a white globose head. This ascigerous sphæridium enlarges in diameter and is pushed upwards by the developing stipe or stem. In mature stages the ascigerous head portion is maroon red with a pinkish tinge, the stipe being pure white in colour. The surface of the sphæridium is papillate on account of the protrusion of the apices of the ostioles, and measures about 1–1·5 mm. in diameter. The stipe measures abo 20 mm. in length and shows a tendency to turn a twist as described by Whetzel and Reddick[3] a others.

The colour of the stroma, the size of the perithe and the ascospores indicate that the species com nearest to, or is identical with, *Claviceps microcephe* (Wallr.) Tul. Petch[4], who made a detailed study *C. purpurea* and *C. microcephala* on *Lolium perenn Glyceria fluitans*, *Festuca arundinacea* and others, co cluded that there were no morphological grounds f separating the two species, and reduced *C. mic cephala* as a synonym of *C. purpurea*. Both the species of *Claviceps* were founded by Tulasne, which *C. microcephala* is always distinguished by t smaller size of the sclerotia, which according Hartwich (Tubeuf and Smith[5]) contain three tim as much ergotin as those of *C. purpurea*. Wh further studies are yet needed to validate Petc conclusions, it seems reasonable to place the *Clavice* species on *Pennisetum Hohenackeri* under *C. mic cephala*.

M. J. THIRUMALACHAR.

Department of Botany,
Central College,
Bangalore.
Oct. 17.

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[1] Ajrekar, S. L., *J. Ind. Bot. Soc.*, **5**, 55 (1926).

[2] Thomas, K. M., Ramakrishnan, T. S., and Srinivasan, K. V., *Pr Ind. Acad. Sci.*, **21**, 93 (1945).

[3] Whetzel, H. H., and Reddick, D., *Phytopath.*, **1**, 50 (1911).

[4] Petch, T., *Naturalist*, London, 25 (1937).

[5] Tubeuf, K. F., and Smith, W. G., "Diseases of Plants", 194 (189

Classification and Nomenclature of Animal Behaviour

IT was suggested in a recent communication[1] th kineses be designated as positive and negative, as done with taxes. The arguments advanced agains the use of 'high' and 'low' for kineses still stand, bu after discussions with other workers and some ex perience of applying positive and negative to specif cases of kineses, these terms do not appear sati factory. For the sake of clarity it seems desirable t apply to kineses terms different from those applie to taxes.

In what has been called a 'high' or 'positiv kinesis the situation is summed up by saying the is a direct relation between temperature and activity in a 'low' or 'negative' kinesis there is an invers relation between them. The straightforward cours is, therefore, to call the former a '*direct* kinesis', an the latter an '*inverse* kinesis'. Thus, when a hig stimulation intensity is associated with a high lev of activity, or low stimulation with low activity, w are dealing with a direct kinesis; when a high stimu lation intensity is associated with a low level activity, or low stimulation with high activity, w are dealing with an inverse kinesis. Dr. D. L. Gun who was among those not entirely satisfied with th proposal to apply positive and negative to kineses[2] informs me that he considers the above new suggestion do meet the case.

J. S. KENNEDY.

Porton,
Salisbury, Wilts.

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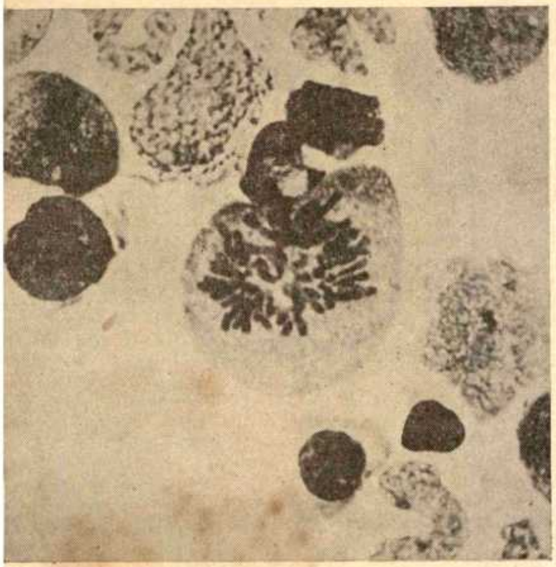
[1] Kennedy, J. S., *Nature*, **155**, 178 (1[illegible]45).

[2] Gunn, D. L., *Nature*, **155**, 178 (1945).

Human Chromosomes

In connexion with Dr. Śliżyński's note[1] on the man chromosomes in bone marrow cells, obtained a sternal puncture, I wish to direct attention to a per published by F. A. Saez and me in 1934[2]. this paper we give details of a method of extracting ne marrow by a sternal puncture in order to in-stigate the human chromosomes, and we conclude at "as to the staining, we obtained good results th May-Grünwald-Giemsa, but other methods may so be used, as—for instance—fixation with osmic id vapour of the fresh smears, and staining with ematoxylin".



Reproduced herewith is a copy of a photomicro-raph of our preparation, made in 1934.

M. E. Varela.

Faculty of Medicine,
Institute of General Anatomy
and Embryology,
University of Buenos Aires.
June 21.

Śliżyński, B. M., *Nature*, 155, 427 (1945).

Varela, M. E., and Saez, F. A., *Rev. Soc. Argent. Biol.*, 10, 421 (1934).

Duration of Life of Woodlice

Some little time ago I published a note on the uration of life of certain species of woodlice[1] which ad been studied by Major Stanley S. Flower and ne, and it was there recorded that Major Flower ad kept a specimen of *Oniscus asellus* Linn. (born n captivity) for approximately 4 years 8 months and 8 days or possibly 4 years 9 months 20 days. My wn record for this same species was 4 years 3 months days.

Major Flower has now very kindly sent me a emale specimen of this species, 18·5 mm. in length, vhich was born in captivity between June 13, 1940, nd August 31, 1940, and died on August 16, 1945. This specimen was thus certainly 4 years 11 months 6 days old and possibly 5 years 2 months 3 days. Apart from the record for *Platyarthrus hoffmanuseggi* Braudt[1] which I kept alive, in captivity, for 5 years months, these constitute the only records I know f where these isopods lived for more than five years.

A further interesting point in Major Flower's letter is the following. Speaking of the above-mentioned specimen he writes, "I have looked at it every day and on August 15, 1945, it appeared to be quite healthy . . . and it was very tame and appeared to enjoy my stroking it with a finger".

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[1] *N. West. Nat.*, 19, 113 (1944).

Steam Tables and Steam Power

In a recent review of "The 1939 Callendar Steam Tables"[1], Dr. H. Heywood concludes by saying that "these tables . . . should meet the requirements for many years of engineers concerned with the design and testing of steam power plant or of heating and ventilating systems". In the light of recent advances in technology and metallurgy this may be thought to be an optimistic forecast. Boiler plant design during fifty years has been consistently ahead of the accurate thermodynamic data upon which it should be based, and the 1939 steam tables can only be said to have caught up with modern practice, leaving little margin for further development in the direction of improved power-cycles.

In our view there are important theoretical considerations which point to an immediate need for extending the data into the unexplored area of the temperature-entropy plane bounded by the temperature range 600°–1,600° F. and the entropy range 1–1·5 B.Th.U. per lb. deg. Fahr. Thus, although a direct extrapolation of the enthalpy data gives no indication of any change in the trend of the pressure-enthalpy relation in this region, the corresponding data calculated from a reduced equation of state indicate the occurrence of a pronounced minimum. The van der Waals' equation, for example, leads to a minimum value of enthalpy when

$$\frac{8t_r}{(3v_r-1)^2} - \frac{6}{v_r^2} = 0;$$

which for steam gives the following values of volume and pressure at three selected temperatures :

Temperature (° F.)	Volume (cub. ft./lb.)	Pressure (lb./sq. in.)
980	0·029	14,000
1340	0·032	19,500
1700	0·035	29,500

The accuracy to be expected from any simple equation of the form $p_r = f(t_r, v_r)$ in the region delineated is, however, not great, and from the point of view of defining conditions for maximum theoretical efficiency direct observations are required.

There should be no insuperable experimental difficulties in exploring this region, since although high pressures are involved the corresponding specific volumes are small. Moreover, the advantages to be derived from the possibility of passing, without phase separation, from supercooled liquid to superheated vapour are considerable, particularly in respect of heat transfer.

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[1] *Nature*, 156, 462 (1945).

A PHOTO-ELECTRIC FOURIER TRANSFORMER

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THE 'Fourier transform' $g(y)$ of a function $f(x)$, usually defined by the integral

$$g(y) = \frac{1}{\sqrt{2\pi}} \int_a^b f(x) e^{-iyx}\, dx, \quad . \quad . \quad . \quad (1)$$

plays an important part in many problems of pure and applied physics. It represents, for example, the connexion between the intensity distribution of a wave scattered by matter of a certain density distribution, which has to be calculated in a number of acoustical and optical problems and, above all, in X-ray crystal analysis work. It further allows the resolution of a complicated oscillation into a continuous frequency spectrum of harmonic oscillations, which is required in many problems of mechanical and electrical engineering. It therefore seems of some importance to have an instrument by which the Fourier transform of a given function can be automatically and quickly produced. We have now succeeded in building up an instrument which produces the graph of the function

$$g'(y) = \int_a^b f(x) \cos(yx + \delta) dx \quad . \quad . \quad . \quad (2)$$

on the screen of a cathode ray oscillograph, from a mask cut out of black paper in the shape of the graph of the function $f(x)$, or from a record of this function on a plate or film in density variation. Obviously two of the functions $g'(y)$ for two values of δ, say, $\delta = 0$ and $\delta = \pi/2$, are equivalent to the complex function $g(y)$ when $f(x) = 0$ for $x < a$, $x > b$.

The method is a photo-electric one, based on a similar principle to that used by Montgomery for discrete Fourier analysis, but extended for continuous Fourier analysis, that is, Fourier integration. A pattern of parallel fringes, with the light intensity varying according to a harmonic function in a direction normal to the fringes, is projected on the mask (or record) mentioned above representing the given function $f(x)$, and the transmitted light is concentrated on the cathode of an electron-multiplier vacuum photocell. The anode current through the cell will then obviously be proportional to the right-hand side of the expression (2) for a given spacing $2\pi/y$ and setting δ of the fringe system. y is now made to vary periodically in time, that is, the fringe system is made to extend and shrink periodically in the following way.

A glass disk, carrying a photographically produced fringe pattern in which the transparency varies sinoidally, is rotated about an axis perpendicular to its own plane. It can be set so as to let the axis intersect the pattern either at a point of minimum density ($\delta = 0$), or maximum density ($\delta = \pi$), or half-way between two such points ($\delta = \pi/2$), or for any other phase required. The disk is evenly illuminated with light from a projector lamp, and a real image of the fringes is produced on an opaque screen with a narrow adjustable slit in it, the axis of rotation of the image passing precisely through the centre of the slit. The light intensity along the slit will then be a sinoidal one with a spacing which shrink and extends periodically in time as the disk rotate Finally, by projecting an image of the slit on th plane of the mask (or record) by means of a cylindric lens, with its cylinder axis at right angles to the sli the optical arrangement is completed.

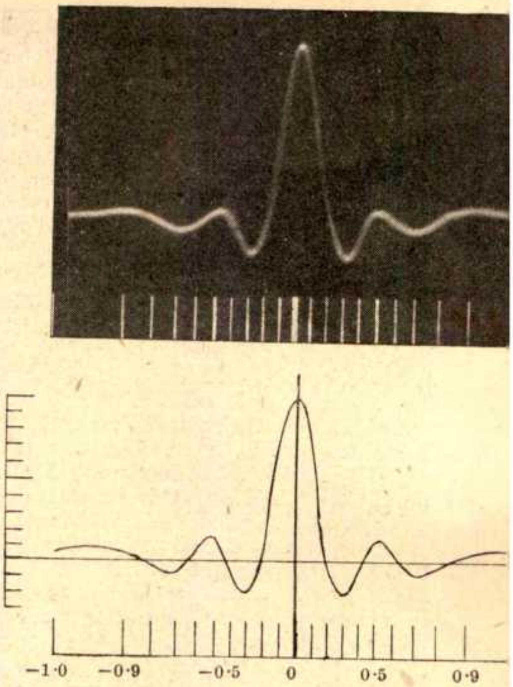

Fig. 1. Above : Record of the Fourier transform

$$g'(y) = \int_0^a C \cos yx dx \simeq \frac{\sin ay}{y}$$

Below : Calculated graph of the same function.

In order to produce the graph of the Fourie transform, the voltage across a resistance in the anod circuit of the photocell is transferred to a cathod ray oscillograph with which is incorporated a tw stage linear amplifier, and a harmonic time base i supplied, synchronized to the rotation of the dis As the replacement of one mask (or record) by an other one, the setting of the phase, and the photo graphing of the trace take only a couple of minutes the new method is apparently capable of producin the required Fourier transforms in a minimum o time.

Figs. 1 and 2 show some examples of the perform ance of the instrument. The records were produce by using the incorporated linear time base of th oscillograph, instead of a harmonic time base, whic has the effect of making the horizontal scale of th graphs non-linear. The correct scale has been inserted at the bottom of each graph. Fig. 1 shows (above) the actual record of the Fourier transfor

$$g'(y) = \int_0^a C \cos yx dx \simeq \frac{\sin ay}{y}$$

and (below) the calculated graph of this function, and gives an idea o the accuracy of the instrument. Fig. 2 shows the records of four other Fourier transforms. We have satisfied ourselves also that in these and many other cases the curves obtained coincide with the calculated ones within the limits of accuracy of the present instrument.

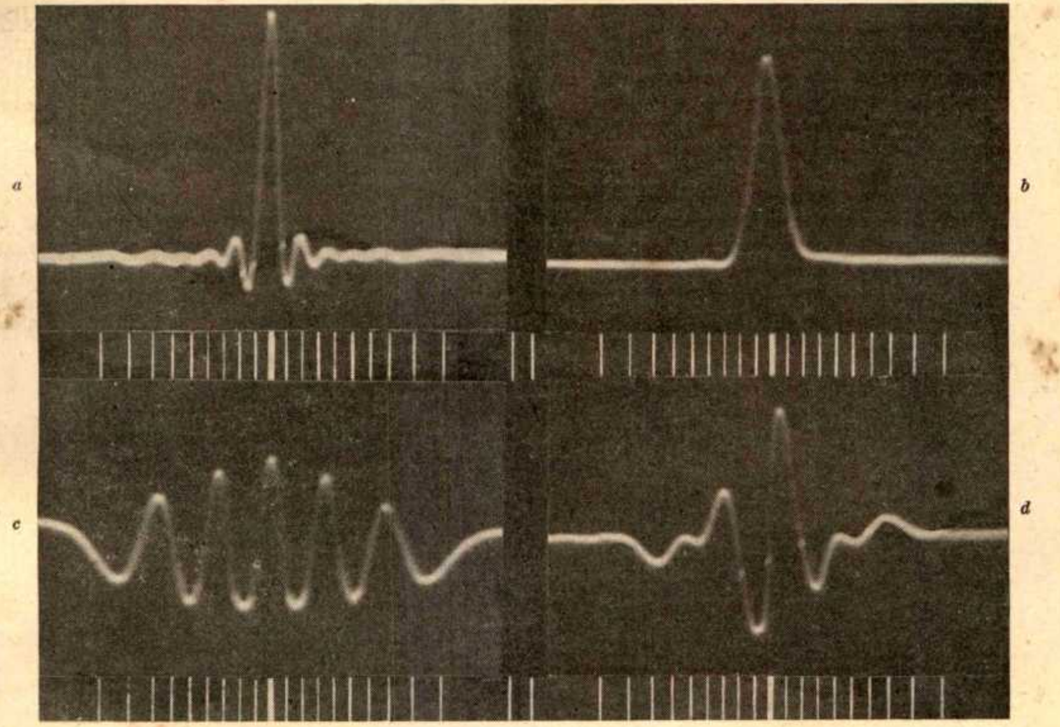

Fig. 2. Records of the Fourier transforms:

(a) $g'(y) = \int_{-A}^{+A} C \cos yx dx \simeq \frac{\sin Ay}{y}$; $(A = 2{\cdot}3a)$;

(b) $g'(y) = \int_{-A}^{+A} e^{-bx^2/2} \cos yx dx \sim e^{-y^2/2b}$;

(c) $g'(y) = \int_{a}^{a+\varepsilon} C \cos yx dx \sim \frac{\cos ay \,.\, \sin \varepsilon y/2}{y}$ $(\varepsilon = a/b)$;

(d) $g'(y) = \int_{a/2}^{3a/2} C \sin yx dx \simeq \frac{\cos ay/2 - \cos 3ay/2.}{y}$

There is little doubt that further technical develop-ent of the instrument will make possible the proıction of Fourier transforms with any reasonably esired accuracy. A detailed description of the new ethod will shortly be given elsewhere.

THE NEWCOMEN SOCIETY

THE jubilee dinner of the Newcomen Society held at Kettner's Restaurant, Romilly Street, W.1, n November 14, when a presentation was made to r. H. W. Dickinson, the chief guest of the evening, r his twenty-five years work for the Society, will ong be remembered by those present. It was on ovember 5, 1920, in the Court Room of H.M. Patent ffice, that the Society held its first general meeting, nd Dr. Dickinson has ever since been an honorary ecretary, except for the two years of his presidency. uring this period he has contributed many papers o the Proceedings, arranged all the summer meetings nd edited the whole of the *Transactions*, while the ontacts he made during his visits to the United tates in 1923 and 1938 had much to do with the apid growth of the Society there, a growth which as led to the formation of a North American Branch s an autonomous affiliated society with a membership xceeding five thousand.

The Society came into existence through a chance onversation between Mr. A. Titley and the late Mr. . W. Hall on September 16, 1919, at the garden party in the grounds of Heathfield Hall, held during the Birmingham commemoration of the centenary of the death of James Watt. This gathering had attracted many engineers with a love of history, and the suggestion of Mr. Titley to the effect that a society should be formed for furthering the study of the history of engineering and technology at once gained support. By May 1920 a provisional committee had been formed at Birmingham, but the Society may be said to have made its debut at a meeting a month later, on June 4, in the offices of Mr. L. St. L. Pendred, editor of the *Engineer*, at 33 Norfolk Street, London, and at a dinner held the same evening at the Savage Club, then in the Adelphi. At those gatherings Mr. Titley was chosen as president, Dr. (then Mr.) Dickinson, honorary secretary, while Messrs. Pendred, Rhys Jenkins and A. W. Hulme were to act as the London committee to collaborate with the Birmingham committee. After much discussion the question of a name for the Society was happily solved by the adoption of the surname of 'the father of the steam engine', Thomas Newcomen, of Dartmouth. Though its membership was small, the Society soon got into its stride, and at the meeting on November 5, 1920, Mr. Hulme read his paper entitled "Introduction to the Literature of Historical Engineering to the Year 1640", which forms a good starting point for any student eager to take up technological history. It appears as the first paper in vol. 1 of the *Transactions*, which contains also two of Mr. Rhys Jenkins' many papers to the Society, Mr. Pendred's "The Mystery of

Trevithick's Locomotives", a paper on "The Invention of Roller Drawing in Cotton Spinning" by the late Mr. A Seymour-Jones, and the presidential address of Mr. Titley, who dealt with the aims of the Society and the ways to achieve them.

From the first, membership of the Society has been open to all irrespective of nationality or sex, and the earliest published list contains names of members in the United States, Germany, Switzerland and China. In its second year the Society adopted an emblem, a griffin, looking backward yet going forward, and also a motto due to the late Colonel Kitson Clark, "*Actorum memores simul affectamus agenda*"; freely translated as "Mindful of what has been done, we strive at the same time after the things yet to be done". It was this idea that ran through some of the speeches at the dinner recently held, Dr. Dickinson urging the need for an influx of young and enthusiastic members to continue a work which is all the more necessary because its significance is not always appreciated.

The dinner had been preceded by the annual general meeting held at the Science Museum, when the twenty-fourth annual report of the Council and two papers were read. The report referred to the renewal of contacts with members abroad who had suffered under the Nazi tyranny, and to the formation of a Midland branch with its headquarters in Birmingham. During the War, a few meetings had to be abandoned; but all the contributions as set down in the programmes had been received and their publication in the *Transactions* only awaits the release of printers and paper. After the passing of the accounts and the re-election of Mr. S. B. Hamilton as president for a second year, a paper followed by Mr. Greville Bathe, of the United States, on "The Onandaga Salt Works of the New York State, 1646–1846". This in turn was succeeded by a review of the work of the Society during the last quarter of a century by the president. The Society, he said, had striven to achieve its objects in many ways: by enlisting the help of individuals and institutions in preserving objects of historical value, by arousing interest in local industrial history by its summer meetings, by the researches of its own members and by the publication of memoirs, by collaboration with societies having somewhat similar aims, by the compilation of bibliographies and by other means. He had classified the 358 papers contributed under the several headings of biography, ancient engineering, local industries, mills, mining, iron and steel, transport, tools, engines and the like, and he remarked that even if the Society were dissolved now, the twenty-one volumes of *Transactions* published, and the four held in suspense by inevitable delays, "are a unique contribution to historical literature". Many of the papers, he said, "are authoritative compilations by outstanding authorities who have made their respective fields peculiarly their own." As the Society has no house of its own, and meeting grounds were often chosen at places appropriate to the paper to be given, Mr. Hamilton concluded his review with an expression of thanks to the director of the Science Museum and to all those who had generously extended to the Society the use of their rooms for gatherings. In conclusion, it may be noted that besides Mr. Hamilton, the officers for the current year are Dr. H. W. Dickinson and Mr. A. Stowers, honorary joint secretaries, Mr. J. Foster Petree, honorary treasurer, with Miss G. Bingham, O.B.E., 43 King's Road, Chelsea, S.W.3, as assistant secretary.

SCIENTIFIC RESEARCH IN INDIA AND THE BRITISH COLONIES

THE first of a series of discussions on t organization of scientific research in the Briti Commonwealth, arranged by the Society for Visiti Scientists, was held at the Society's House at 5 O Burlington Street, London, on December 5, wi Prof. A. V. Hill in the chair. The speakers were Dr. S. Siddiqui, director of the Chemical Laboratori C.S.I.R., Delhi; Dr. J. L. Simonsen, director of t Colonial Products Research Council; Dr. E. Worthington, secretary of the Freshwater Biologic Association, and author of the section on "Scienc in Africa" in Lord Hailey's "African Survey" Major-General Sir John Taylor, late director of t Central Research Institute, Punjab. Those who too part in the subsequent discussion included: D W. R. Aykroyd, director of the Nutrition La oratories, Coonoor, Central India; Sir Lewis Fermo late director of the Geological Survey, India; M C. Y. Carstairs, assistant secretary at the Coloni Office; Dr. C. H. Waddington, and Dr. C. Gordon.

Among the chief points made were the following In India, government expenditure on research no amounts to the modest total of about £200,000 pe annum, but the Council of Scientific and Industri Research, which was founded in 1942, has drawn u a five-year plan for research, to be supervised by proposed new National Research Council. The tot expenditure under the plan would be £4,500,000, c which a considerable fraction would be found b industry. It would include grants for the training c a large number of urgently needed additional scientific personnel.

The outstanding results of scientific research i India to date have been in the field of tropica medicine. Here the Central Research Institute ha similar functions to the Medical Research Counc in Britain; through the Nutritional Advisory Committee, special consideration is given to nutritiona problems. The Indian Geological Survey, establishe about a century ago, is expanding its activitie notably in relation to the discovery of new minera resources and to the development of hydro-electricity

Both in India and the Colonies, nutrition is of outstanding importance. However, it has been foun that it cannot be tackled as an isolated researc problem, but requires the study of many subjects including water supply, soil erosion, malaria, agricultural science, land tenure, supply organization demography and education.

In the course of the discussion, other example emerged of problems which could only be properly tackled by this method of co-operating teams, ofte including students of both the natural and socia sciences: for example, public health and wate resources, the latter involving geology, soil-science, fisheries, meteorology, etc. The success of this method in operational research during the War was emphasized. Broad ecological research is increasingly necessary in tropical countries, and this too demands the co-operation of specialists from a number of fields.

In addition to the classical methods of research by subjects, and to this development of research and problems by wide teams, the method of research by 'sample areas' has recently been proved to be very effective. This was first tried in three different villages of Cyprus, one in the mountains, one in the foothills, one in the plains, where experts in medicine, estry, agriculture and water supply are all co-erating. This method has also been used in the lonies, and its general employment was discussed the Quebec Conference on Food and Agriculture.

One point brought out during the discussion was e disparity now existing between wealthy and poor rritories in regard to expenditure on science and applications. Thus in Malaya, the expenditure medical and health services is about 5*s*. a head of pulation, while in India, it varies from about 2*d*. 1*s*. according to district.

The need for co-operation between scientific workers the Dominions and the Colonies was stressed. Here e Empire Scientific Conference, which is to be held 1946, holds out great promise.

Another need is for the raising of the status of the ientific worker in Colonial government service, so at he can occupy the same sort of position as a search worker in a good university at home. One ay in which this could be achieved might be by ving in each territory or regional group of territories director of research, who would also be scientific lviser to the Government concerned, and to whom ientific workers in all fields should have direct access.

One of the most urgent problems in India and the olonies is the study of industrial processes which can e utilized locally. Thus the conversion of molasses to industrial alcohol could be undertaken in sugar-rowing countries, and the setting up of plants for xtracting oil from oilseeds in Africa would provide rge amounts of cattle food urgently required there. n this connexion, the decision to found a Microiological Research Station in the West Indies is of reat importance.

The discussion proved of great interest in focusing nformed opinion on the urgent problems of research n India and the Colonies.

SWEDEN'S WATER-POWER RESOURCES

DURING the War, sixty new power stations were built in Sweden, several of more than 40,000 kW. ating. The production of hydro-electric power in 944 was 12,417 million kWh., and water-power lants now total about 2,500,000 kW. Further plants otalling about 600,000 kW. will be completed towards 1950, and works have been started for an dditional 350,000 kW. The energy utilized in 1944 was 10,573 million kWh., of which 4,428 million kWh. were taken by the large industries for engine power, tc., while the electro-chemical and thermo-electric industries consumed 1,891 million kWh. About ,040 million kWh. were used for traction purposes and 2,017 million kWh. for domestic purposes, etc. ,093 million kWh. were used for electric steam-generation at night-time and during non-working hours.

Plants built during the War cost about £17,647,000, and subsequent investments amount to about £3,530,000 a year.

During 1944, plant additions amounted to 280,000 kW. Plants for a further 46,000 kW. will probably be completed before the end of 1945. Among the new power-works to be completed within the next five years or so are those at Hjälta (120,000 kW.), Forsmoforsen (75,000 kW.), and Námforsen (46,000 kW.), situated on the Ångerman River with the tributary Fax River. One station of 46,000 kW. will be built at Skedvi on the Dalalven River and one of 34,000 kW. on the Ljusnan River.

A new station at the Harsprånget waterfall in the Lule River will have a capacity of 250,000 kW. The Suorva Dam at the Stora Lulevatten, the well-lake of the Lule River, has created a water storage with a maximum capacity of 113,000 million cu. ft. and a regulating height of 19½ ft. for the new station as well as for the existing Porjus plant.

The total Swedish water-power resources which can be exploited economically is estimated to correspond to about 36,000 million kWh., of which one third has been utilized, while the second third is now being gradually taken into use. The last third will, however, be comparatively expensive to develop.

The networks of all the large power-plants are interconnected, and four heavy copper and steel-aluminium transmission lines, stretching from the north of Sweden down through the whole country, constitute the arteries through which a large part of the country's electric energy is being supplied to industries, railways and households.

NON-METALLIC DEPOSITS OF THE U.S.S.R.

A NEW publication by the Academy of Sciences of the U.S.S.R., "Non-metallic Deposits of the U.S.S.R." (published in Russian), is planned on a large and comprehensive scale. Judging by the volume at hand (Vol. 2, 1943) this publication will extend over a number of volumes and greatly exceed a similar work published in four volumes during 1926–29, as the subjects discussed in the present volume cover 449 pages as compared with 96 pages of the previous edition. Volume 2 contains the following articles, each written by a specialist or a group of specialists on the given subject: (1) basalt and diabase, (2) barite and witherite, (3) beryl, (4) turquoise ("Biruza" in Russian), (5) bitumens and bitumenous rocks, and (6) bauxite. Each section comprises the following items: general description of the material and its mode of occurrence and genesis, localities where it is found, especially those in the U.S.S.R., methods of extraction and technology, economic statistics and bibliography.

The value of this work is manifold. First, because it gives a very full account of the localities and mode of occurrence of mineral deposits, especially those found in the Soviet Union, secondly because it provides new and interesting interpretations of data, classification, genesis and novel industrial uses. Such, for example, is the article by A. S. Ginsberg on basalt and diabase (dolerite), rocks which are extremely abundant in Britain and used mainly for road-metal, while in the Soviet Union, at the present time, they are also used for manufacturing electrical insulators, acid-resisting tanks and many other articles of industrial value, in the form of the so-called 'cast basalt'. The section on bitumens, written by a group of specialists, is of exceptional interest, especially the part written by V. A. Uspensky on the genesis and genetic classification of bitumens and also that written by A. P. Vinogradov on the occurrence of certain chemical elements, such as vanadium, nickel and uranium, in bitumens. Sections describing the occurrences of bitumens in the U.S.S.R. and the technology of bituminous products are also very interesting. The prospecting for bauxitic ores in the

U.S.S.R. has been carried out on a very extensive scale during the last two decades, and the collection of articles on this subject provides a valuable summary of the results achieved as it gives detailed accounts of the various new bauxite localities of the Urals, Kazakhstan, Siberia and Central Asia.

On the whole, this publication, of which many more volumes are projected, promises to serve as an authoritative reference book to the mineral resources of the U.S.S.R.; it is of interest to geologists, miners and technologists of all countries, provided that they are familiar with the Russian language.

S. I. TOMKEIEFF.

FORTHCOMING EVENTS

Thursday, December 27

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Sir Robert Watson-Watt, F.R.S.: "Wireless" (Christmas Lectures adapted to a Juvenile Auditory, 1).

Friday, December 28

INSTITUTE OF WELDING, EAST SCOTLAND BRANCH (at the Heriot-Watt College, Chambers Street, Edinburgh), at 7.30 p.m.—Mr. F. Clark: "Non-Ferrous Welding".

Saturday, December 29

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Sir Robert Watson-Watt, F.R.S.: "Wireless" (Christmas Lectures adapted to a Juvenile Auditory, 2).

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

ENGINEERING ASSISTANTS (2) in the Borough Engineer's Department—The Town Clerk, Municipal Buildings, West Hartlepool (December 29).

LABORATORY STEWARD at the Swindon Technical Institution and Secondary School—The Director of Education, Education Office, Civic Offices, Swindon (December 29).

MECHANICAL ENGINEER (to organize and supervise the design and manufacture of machinery for use on Peat Bogs)—The Secretary, Turf Development Board, Ltd, 21 Fitzwilliam Square, Dublin (December 31).

TEACHER (full-time) OF ENGINEERING WORKSHOP PRACTICE—The Principal, Twickenham Technical College, Egerton Road, Twickenham, Middx (December 31).

ASSISTANT MASTER with qualifications in MATHEMATICS, PHYSICS, or ENGINEERING, a LECTURER IN BIOLOGY, and a LECTURER IN MECHANICAL ENGINEERING, in the Denbighshire Technical College—The Director of Education, Education Offices, Ruthin, Denbighshire (January 5).

ENGINEERING ASSISTANT, Grade E, in the Public Works Department—The Borough Engineer and Surveyor, Council House, Walsall, Staffs. (January 7).

CITY ENGINEER AND SURVEYOR—The Town Clerk, Town Clerk's Office, Bradford, endorsed "City Engineer and Surveyor" (January 8).

CIVIL ENGINEER (with special experience in Building), MECHANICAL ENGINEERS (with Works and Design experience), and MECHANICAL DRAUGHTSMEN (with Works Training and experience in Machine Design)—The Secretary, Turf Development Board, Ltd, 21 Fitzwilliam Square, Dublin (January 10).

DIRECTOR OF RESEARCH to take charge of a Research Laboratory to be set up in the Midlands for the British Sugar Corporation—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting F.5532.XA (January 11).

PRINCIPAL OF THE DUNDEE TECHNICAL COLLEGE—The Clerk and Treasurer, Dundee Technical College, Bell Street, Dundee (January 12).

ASSISTANT ENGINEER—The Secretary, Burnham, Dorney and Hitcham Waterworks Company, High Street, Burnham, Bucks. (January 12).

ELECTRICAL ENGINEER AND MANAGER of the Brighouse Electricity Undertaking—The Town Clerk, Town Hall, Brighouse, endorsed 'Electrical Engineer and Manager' (January 16).

TEACHER (full-time) OF STRUCTURAL ENGINEERING SUBJECTS at the Brixton School of Building, Ferndale Road, London, S W.4—The Education Officer (T.1), County Hall, London, S.E.1 (January 16).

TEACHERS (full-time) OF MECHANICAL ENGINEERING SUBJECTS at the South-East London Technical Institute, Lewisham Way, London, S E 4—The Education Officer (T.1), County Hall, London, S.E.1 (January 18).

PRINCIPAL OF THE COUNTY TECHNICAL COLLEGE, Dartford, and REGIONAL PRINCIPAL FOR TECHNICAL EDUCATION in the area served by the College—County Education Officer, Kent Education Committee, Springfield, Maidstone (January 23).

PHYSICAL CHEMISTS or PHYSICISTS in connexion with development of Plastics—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C 2, quoting F.5261.XA (January 25).

LECTURER IN MECHANICAL ENGINEERING (Ref. No. C.2931.A), LECTURER IN ELECTRICAL ENGINEERING (Ref No. D.1557.A), LECTURER IN WIRELESS ENGINEERING (Ref No. D 1558.A), LECTURER in INSTRUMENTS TECHNOLOGY (Mechanical) (Ref. N C.2978.A), and a LECTURER IN INSTRUMENTS TECHNOLOGY (Optic (Ref. No. C 2979.A), under the Military College of Science, Stoke-c Trent—The Ministry of Labour and National Service, Appointmen Department, Technical and Scientific Register, Room 670, Yo House, Kingsway, London, W.C 2, quoting the appropriate Ref. N (January 26)

ILLUMINATION ENGINEER to undertake development work on t application of plastics in the lighting field—The Ministry of Labour a National Service, Appointments Department, Technical and Scienti Register, Room 670, York House, Kingsway, London, W.C.2, quoti D.1629 XA (January 28).

SECRETARY TO THE MEDICAL SCHOOL—The Dean, St. Thomas Hospital Medical School, London, S.E.1 (January 31)

PHYSICAL CHEMIST to evolve polarographic and other metho suitable for the analysis of plants and supervise their routine, u and a PHYSICIST to evolve spectrographic and other methods suitab for the analysis of plants and supervise their routine use—The Secr tary, East Malling Research Station, East Malling, Maidstone, Ke (January 31).

LECTURER IN CHEMICAL ENGINEERING in the Department of O Engineering and Refining—The Secretary, The University, Edmun Street, Birmingham 3 (February 1).

LECTURER IN THE DEPARTMENT OF LEATHER INDUSTRIES—T Registrar, The University, Leeds 2 (February 28).

LECTURER IN PHYSIOLOGY—The Secretary, Queen's Universit Belfast (March 31).

REGIONAL DIRECTOR (West of Scotland) and DIRECTOR OF CENTRA DEPOT (Western Area) at Glasgow (joint appointment), and a REGIONA DIRECTOR (South-East Scotland) and DIRECTOR of CENTRAL DEP (Eastern Area) (embodying Plasma Drying Unit) at Edinburgh (joi appointment)—The Secretary, Scottish National Blood Transfusi Association, 10 Duke Street, Edinburgh 1 (April 20).

PROFESSOR OF PHYSICS—The Principal, Heriot-Watt Colleg Edinburgh (April 22).

TECHNICAL ASSISTANT (Hæmatology) (non-resident, male or femal for Clinical Laboratory Work—The General Superintendent an Secretary, Royal Infirmary, Manchester.

ASSISTANT PHYSICIST in the Radiotherapy Department—The Hou Governor, London Hospital, Mile End, London, E.1.

PROFESSOR OF PHYSIOLOGY in the University of Ceylon—Th Secretary, Universities Bureau of the British Empire, c/o Universit College, Gower Street, London, W C.1.

LECTURER IN MATHEMATICS in the Natal University Colleg Pietermaritzburg—The Secretary, Universities Bureau of the Britis Empire, c/o University College, Gower Street, London, W.C.1.

CURATOR-LIBRARIAN (experienced) by an Oil Company in Ira to take charge of literature and fossil collections in geological lab oratory—The Ministry of Labour and National Service, Londo Appointments Office, 1-6 Tavistock Square, London, W.C.1, quoti F.A.158.

BIOCHEMIST or CHEMICAL ANALYST (graduate, experienced), an HOSPITAL or LABORATORY TECHNICIANS, for work with nutrition team in Germany—The Director, Oxford Nutrition Survey, 10 Park Road, Oxford.

LECTURER (full-time) IN AUTOMOBILE ENGINEERING for Day an Evening work—The Principal, Leicester College of Technology an Commerce, The Newarke, Leicester.

RESEARCH ASSOCIATE—The Secretary, National Institute of Economic and Social Research, 53 Romney Street, London, S.W.1.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Freshwater Biological Association of the British Empire. Thirteent Annual Report for the Year ending 31st March 1945. Pp. 42. (Ambleside: Freshwater Biological Association, 1945.) 1*s*. 6*d*. [6

Ministry of Health: Nurses Salaries Committee. Mental Nurse Sub-Committee. Further Recommendations. Mental Nurses S.C Notes, No. 4. Pp. 4. (London: H.M. Stationery Office, 1945.) 1*d* net. [6

The Journal of the Institute of Metals. Vol. 70, 1944. Edited by N. B. Vaughan. Pp. xlvii+614+65 plates. (London: Institute o Metals, 1944.) [6

Metallurgical Abstracts (General and Non-Ferrous). Vol. 11, 194 (New Series). Edited by N. B. Vaughan. Pp. viii+514. (London Institute of Metals, 1944.) [6

Lecture on Cement and Concrete. By Dr. F. M. Lea. Pp. 30 (London: Royal Institute of Chemistry, 1945.) [13

Lecture on Chemistry and Clothing. By D. A. Clibbens. (First Dalton Memorial Lecture.) Pp. 16. (London: Royal Institute of Chemistry, 1945.) [13

The Health Services in Austria: Problems of Medical Reconstruction and Rehabilitation. Pp. 40. (London: Association of Austrian Doctors in Great Britain, 1945.) 3*s*. [139

Ministry of Fuel and Power: Committee on Efficient Use of Fuel Fuel Efficiency Bulletin No. 40: Combined Power and Heating Fuel Efficiency Bulletin No. 42: The Recovery of Waste Heat from Fuel Gases. (London: Ministry of Fuel and Power, 1945.) [25

Catalogues

A Catalogue of Rare and Important Books on Zoology, includin some Important Works on Fisheries and the Fine Ornithological Work of John Gould; Geology, Botany, Agriculture, Forestry, Fruit-Cultur and Gardening. (No. 632.) Pp. 92. (London: Bernard Quaritch Ltd., 1945.) 6*d*.

Priced Catalogue of B.D.H. Laboratory Chemicals and Testin Outfits. Pp. vi+242. (London: The British Drug Houses, Ltd., 1945.)

NATURE

No. 3974 SATURDAY, DECEMBER 29, 1945 Vol. 156

CONTENTS

Page

nicillin : a Study in Co-operation 761

ence and Mysticism. By Dr. G. Lapage . . 763

Great Physiologist. By Prof. C. Lovatt Evans, F.R.S. 764

counting for Farmers 764

emistry of Penicillin 766

nerican Work on the Atomic Bomb Project. By Prof. N. Feather, F.R.S. . 768

nicillin in the Treatment of Syphilis. By Dr. James Marshall . . . 769

ituaries :

Prof. J. T. Wilson, F.R.S. By Dr. H. L. H. H. Green 772

Prof. W. H. Fraenkel. By E. Scheuer . . . 773

Dr. William Cramer. By Dr. R. J. Ludford . . 773

ews and Views 774

tters to the Editors :

Determination of Factors Injurious to Plants in Acid Soils.—Prof. T. Wallace, E. J. Hewitt and D. J. D. Nicholas 778

Measurement of the Diameters of the Living Eye by Means of X-Rays.—Prof. Arnold Sorsby and A. D. O'Connor 779

An Induced Carcinoma in the Fowl.—F. Bielschowsky and Prof. H. N. Green . 780

A Fatal Case of D.D.T. Poisoning in a Child.—Major K. R. Hill and G. Robinson . . . 780

Adsorption of Enzymes on Solid Nucleic Acid.—Dr. J. A. V. Butler . . . 781

Inhibition of the Development of *Fusarium oxysporum cubense* by a Growth Substance produced by Meredith's Actinomycetes.—Dr. A. C. Thaysen and K. R. Butlin . . . 781

Insecticidal Properties of *Euphorbia* Extracts.—F. L. Vanderplank 782

Aerial Bactericides.—J. E. Lovelock . . 782

Unit Cell and Space-Group of Co_2Al_9.—Audrey M. B. Parker 783

A New Test for 2 × 2 Tables.—G. A. Barnard . 783

Mechanism of the Benzidine and Related Rearrangements.—M. J. S. Dewar 784

Properties of Optically Isomeric Mepacrines.—Prof. G. F. Gause 784

pplication of New Methods of End-Group Determination to Structural Problems in the Polysaccharides. By F. Brown, Sonia Dunstan, T. G. Halsall, Prof. E. L. Hirst, F.R.S., and J. K. N. Jones . . . 785

ammary Cancer in Mice. By Dr. E. Boyland . . 787

tudies in Compregnated Wood 787

ecent Scientific and Technical Books . . Supp. ii

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PENICILLIN: A STUDY IN CO-OPERATION

MUCH has recently been heard of co-operation between scientific workers of Great Britain and of the United States in physical research, and the successful outcome of the work which culminated in the production of the atomic bomb has been widely quoted as an indication of the value of such co-operative effort and the desirability of its continuation in the future. With the publication of the statement on the chemistry of penicillin which appears in this issue of *Nature* (p. 766), there is revealed the existence of another co-operative effort in research, directed towards a very different end. This publication may serve to correct the general but mistaken impression that scientific work during the War has been mainly concerned with the destruction of man. It is of some interest to consider the background against which this extensive collaboration in work on penicillin was developed and the implications which it carries for the future.

As soon as the potential importance of penicillin as a therapeutic agent had been demonstrated by Florey and his collaborators, intensive chemical work on the substance was initiated in Florey's own laboratory and in the Department of Chemistry at Oxford. From the time of the formation in 1942, at the instance of the Ministry of Supply, of the General Penicillin Committee, which was charged with the duty of doing everything possible to increase production of penicillin, other academic and industrial laboratories in Great Britain were drawn into the work and a considerable measure of co-operation was achieved in this country.

As the work on the constitution of penicillin proceeded, and as the formidable difficulties of large-scale microbiological production of the substance were realized, the question of the development of a synthesis acquired considerable urgency, and through the Medical Research Council steps were taken to make the collaboration between British chemists engaged on the problem more intimate and effective. For this purpose the Council set up a Penicillin Synthesis Committee (under the chairmanship of Sir Robert Robinson, Waynflete professor of chemistry in the University of Oxford), which included distinguished chemists from both academic and industrial organizations working on this subject. By this time it had become apparent that, owing to the difficult situation in Great Britain, and to the greater resources of labour, material and technical knowledge of microbiological methods in the United States, it was from America that really large-scale microbiological production of penicillin was first to be anticipated. That this anticipation has been realized is now a matter of common knowledge; what could not be foreseen at the time was that the most hopeful expectations would be far exceeded by an effort in the industrial application of microbiology which is probably without parallel in the past.

The development of the national effort in the microbiological production of penicillin in the United States naturally involved American chemists in work similar to that which had already been begun in Great Britain on the constitution of penicillin with a view to its subsequent synthesis. The potentialities of penicillin not only in matters affecting the health of the civil population but also in directly assisting military operations by controlling infection of wounds, and thus reducing disability, were fully realized both in Britain and in the United States ; this realization brought the recognition that work directed towards synthesis, which at that time seemed to offer the best prospect of the rapid production of the substance in large quantities, was a matter of the greatest importance to both countries.

Since this conviction was shared on both sides of the Atlantic, it was possible for the Medical Research Council to arrange with the Office of Scientific Research and Development in Washington, which itself was co-ordinating American work on penicillin on behalf of the United States Government, for the complete and up-to-date exchange between the two countries of all research information bearing on the synthesis of penicillin. Thus, the Penicillin Synthesis Committee of the Medical Research Council referred to above became a co-ordinating centre in Britain not only for all British research on the constitution and synthesis of penicillin but also for the complete Anglo-American collaborative effort. The statement which is now published gives an outline of the unequivocal results obtained in Britain and in the United States both before and during the operation of this collaborative arrangement, up to the middle of 1944.

Full assessment of the value of the chemical work which has resulted from the international co-ordination of research on this subject must naturally await the complete publication of the results, which it is hoped may not be long delayed. In the meantime, however, the impressive amount of this work is immediately apparent from the preliminary statement, which also brings to light other facts of interest. The first is the extraordinary and unexpected difficulty of the problem. The molecule of penicillin is not large, and, as the statement indicates, the general features of its structure are revealed by identification of the products of acid hydrolysis ; on the other hand, some of the transformations undergone by penicillin are not easy to explain and it is clear that there has been difficulty in reaching finality about its constitution. A measure of the magnitude of the problem is afforded by perusal of the list of groups both in Britain and in the United States which have participated in the work, and this list is itself a second matter of interest to which attention may be directed. Not only have some of the most distinguished organic chemists in both countries directed their efforts to the problem, but also every potentially useful phys.co-chemical and physical technique has been brought to bear on it. Never before indeed can there have been such a concentrated attack on the chemistry of a single compound. It seems that penicillin is almost as remarkable in the tenacity with which it holds the secrets of its molecular structure as it is in the biological properties which give it its peculiar importance.

Whether or not we are ultimately to learn that t collaborative research on penicillin has led to succe the announcement that such a collaboration has be possible at all is an event of considerable significanc A few years ago it would have been quite inconceivab that a project with such possibilities of commerc development could have been the subject of pool research, involving a completely free interchange information, between a group of organizations suc as those listed at the end of the statement ; this li includes, for both Britain and the United State academic laboratories, government research institu tions and the research departments of industrial fir which are normally commercial competitors. Tho who have knowledge of the working of the arrang ment are aware of, and have been impressed by, th complete loyalty with which all participants hav observed the conditions of co-operation.

Even if it be admitted that such a collaboratio in research on a subject of potential commerci value could only have been arranged under th special conditions prevailing in war-time, when th motive of commercial competition is submerged b that of defence of the country, the evident succes of the temporary arrangement is certainly a goo omen for the future. It becomes increasingly clea that for the advance of science in any country particularly perhaps for the advance of chemistr and physics, a closer co-ordination is desirable tha has hitherto existed between the research work whic is done in universities, government institutions an industrial laboratories. Of the difficulties whic have stood in the way of such co-ordination in th past, the greatest is probably the inevitable diffe ence of outlook induced by the necessities of com mercial practice. This has tended to set up a barrie between the academic research worker whose trad tions demand free publication of all results and fre interchange of information with his scientific col leagues, and the industrial research worker whos first duty is to the interests of his own firm. With th resumption in peace-time of normal commercia practice, this difficulty will necessarily reappear an it is useless to minimize its seriousness. Nevertheless even the temporary breakdown of the barrier by a collaborative arrangement such as has operate during the last few years in the field of penicilli chemistry can scarcely fail to exercise a lasting effec for the good. On one hand, the academic participants will have had an opportunity, such as coul not otherwise have been afforded to them, of learning something of the quality of research work which is carried out in industrial organizations, and they will certainly thereby have acquired a greater respect for this work ; on the other hand, it may be hoped that the industrial research workers may have become more impressed than they formerly were with the very real benefits which may be derived in scientific work from free consultation and discussion with colleagues. If such a conviction were established, it would probably also result in a change of policy in the direction of prompt and complete publication of scientific results from industrial research laboratories to the maximum extent consistent with adequate tection for development; no move could be more ourable to the recruitment of able scientific rkers to industry than an increase in the oppor- ities afforded to them for publication and, ough this, for the development of a scientific eer.

f the collaborative research on penicillin has been ective in starting a move in the directions indicated, s may ultimately be counted a contribution to the vancement of science as important as the actual entific work for which the collaborating parties ve been responsible.

SCIENCE AND MYSTICISM

e Physical Basis of Personality

Prof. V. H. Mottram. (Pelican Books, A.139.) . 126. (Harmondsworth and New York: Penguin oks, Ltd., 1944.) 9*d*.

N this book the reader will find a stimulating discussion of known facts about heredity, genes, docrine organs and related biological conceptions. e terminology of these conceptions is freely used wadays, often without a clear understanding of its eaning. It is therefore important that this meaning ould be precisely understood. For this reason alone is book should be read.

Apart from this point, however, the book is worth ading for the sake of its last chapter entitled Recapitulation and Coda". If some readers reject e author's criticism of the determinist materialist ilosophy which is so popular nowadays (again often ithout adequate understanding of its full implicaons), others will welcome the method which the thor adopts of avoiding the pessimism and unppiness which materialism so often brings. The ay indicated is a mysticism reconciled with scientific scovery. It will not be everyone's way of meeting e philosophical challenges of science. At least one ther way is available, namely, the lonely way exounded by Sir Charles Sherrington in his "Man on s Nature", which book Prof. Mottram highly comends. Commendable Sir Charles Sherrington's book ost certainly is, in spite of its difficult style; but counsels a solution which the mystic could not dopt. For Sherrington there can be no leaning for ounsel and guidance upon a higher mind or personaly. Man must shoulder his burden alone; and by cceptance of that "loftier responsibility", he is aised, in Sherrington's opinion, to "a rank of obligaion and pathos which neither Moses in his law-giving or Job in all his suffering could present".

This attitude, admirable though it is, requires for s acceptance a mind too subservient to logic and the cientific method to be representative of the newest evelopments of human intelligence. Much recent riting indicates this. To mention only one example, r. Clark-Kennedy, in his lecture on "The Art of edicine in Relation to the Progress of Thought" Cambridge University Press, 1945), has ably set out ome of the reasons why science is not enough for he proper practice of the art and science of medicine. Mottram, in the book under consideration, and the thers, ancient and modern, whose work he quotes, emind us of an experience less tragic, if no less ifficult, than that indicated by Sir Charles Sherringon—an experience which has been variously called communion with an inner spirit or reality, the quest of the world-soul, submission to the absolute (which does not, be it noted, necessarily involve acceptance or even understanding of Hegelian philosophy), the search for the spirit of the whole or accordance with the inner necessity. Yet others, like McTaggart and Younghusband, have frankly and simply called it love. It is an experience which all of us may have if we will; we may have it, too, without any very esoteric disciplines. Most men of science, in any event, will probably be able, if they are honest with themselves, to apply to their own experience Sir Olaf Stapledon's description, quoted by Mottram from Stapledon's "Saints and Revolutionaries", of that "very comprehensive act of attention, an attending to everything at once, or to the wholeness of everything at once" which brought to Stapledon "a tension of fervour and peace" and might easily, he goes on to say, be regarded, if he were less sceptical, as some kind of contact with God.

One way of experiencing this kind of emotion—and of doing so without necessarily excluding God—is to watch, in the circle of green light beneath a microscope, the ways, say, of the trypanosome which can, and inevitably will, if conditions are favourable, kill a Christ and a Hitler alike. The proper understanding of the conditions necessary for this entirely inhuman and amoral act requires an intellectual discipline, maintained for many years of close and exacting study, which the orthodox mystic can scarcely comprehend. The mere act of looking down a microscope will not provide it, though the microscope can, like the rites prescribed by orthodox mysticism, shut out the disturbances of the immediate surroundings and focus the attention. It can focus the attention, moreover, upon those small details which, both by their cumulative effects and their individual significance, reveal to the experienced mind a good deal which the philosopher, who looks at the landscapes of science rather than at their several components, cannot possibly apprehend. It can focus the attention, in addition, upon those minute inexactitudes which at once justify the disciplines of the scientific method and at the same time reveal its limitations. It can endow the observer with a "snail-horn delicacy of perception" which is essential to any effort towards the understanding of those wider landscapes which the philosopher seeks to delineate.

The remainder of the mystic procedure will come naturally to the man of science. The elimination of the self, so far as this is possible to the Adam in us, is habitual to the scientific worker, who cannot, unless he achieve some considerable measure of it, begin to work at all. To him also comes naturally that deep and essentially religious awareness of abstract beauty, which goes so far beyond the appreciation of beauty of form—the realization, in other words, of the difficult beauty of adaptation, evolution, development and obedience to natural law. The slow and inspiring growth in the mind of all that this kind of beauty implies comes only, during the years, from the disciplines of study, disappointment and refusal to escape into easier ways; and these are disciplines as difficult as any that the orthodox mystics have enjoined. When knowledge is thus gained in any field of scientific work, and is related, as only the experienced man of science can relate it, to the same kind of knowledge won from the similar study of other aspects of the universe, then the mind experiences, in rare moments of synoptic insight, a reverent and exhilarating certainty of the essential unity of all phenomena appreciable by the mind, and of the omnipresence of an inner reality pervading all, which inspires and pervades the whole life and character of him who experiences it. It is this that equates the amœba with him who has thought his apprehension like a god's; it is this which has created, out of truth and beauty, the atomic bomb which awaits man's dedication of it, in action and not merely in a form of words, to the service of the good; it is the germ of this which Prof. Mottram offers to those who read his book.

For this reason, if for no other, this book can be commended to all those who are seeking at this moment—and desperately seeking—some reintegration of that belief in the existence and even in the good purpose of an inner reality which the recent War, and the evil of those who instigated it, may seem to have shattered beyond recovery. It shows beautifully the moral worth of the service of the truth. Read sincerely and with imagination, it spans the ages of man's experience. With the terrible charity which modern truth must exercise, it links the modern microscope with "the eye of my soul" which beheld, "above my mind, the Light Unchangeable".

G. LAPAGE.

A GREAT PHYSIOLOGIST

Léon Fredericq et les débuts de la physiologie en Belgique

Par Prof. Marcel Florkin. (Collection Nationale, Troisième Série, No. 36.) Pp. 104. (Bruxelles: J. Lebègue et Cie., 1943.) n.p.

PHYSIOLOGISTS the world over, and especially in Belgium, have reason to be proud of Léon Fredericq. Born in 1851, he became an outstanding figure in the classical period of physiology. Between 1870 and 1880, the institutes of physiology for the promotion of teaching and the encouragement of research, which came into being in various countries, necessitated the creation of whole-time chairs of physiology. In Belgium such innovations were encouraged by the State, and Léon Fredericq was appointed to the chair at Liège in 1879 in succession to Théodore Schwann, and charged with the creation of a new Institute of Physiology, which was completed in 1888. In the forty-two years during which he directed the Institute, it made history, and on reading this elegant little essay, one realizes why so high a place in world physiology is held by so small a country.

Fredericq's knowledge was encyclopædic, his experience wide and his talents manifold. Among the latter was high ability as a popular lecturer and as a water colourist. A great naturalist, we owe much to his researches in the comparative field, his most memorable discovery being that of hæmocyanin.

His contacts were closest with France and Germany, and though he had many friends in Britain too, his work was less well known here than it should have been. It is not generally known, for example, that he invented an apparatus, the oxygénographe, applicable for use on man, for reading off oxygen utilization, and recognized by Benedict as a prototype of the arrangement which he so extensively used. He was the initiator of the technique of crossed circulation, and his work on the respiratory exchange as reveal by tonometric determinations, on the left auricu pulsations as studied by œsophageal sounds, and the time relations of events in the cardiac cycle, widely known. Much of his work was biochemi and included investigations on blood coagulatio in the course of these he recognized the three ma proteins of the plasma.

The book is full of interest, and is a valua contribution to the history of physiology, wi thoroughly painstaking bibliography and footnot

C. LOVATT EVANS.

ACCOUNTING FOR FARMERS

Good Farm Accounting

By A. C. Campbell. (Teach Yourself Farming Serie Pp. 200. (Bickley: English Universities Pres Ltd., 1945.) 3*s*. 6*d*. net.

IF there is one branch of farming that can be lear from books it must certainly be book-keepin Formerly farmers were inclined to regard accoun as an unnecessary encumbrance in a life mostl spent in field and market; but recent changes taxation have compelled practically all of them provide statements of their affairs that will satisf the Inland Revenue authorities.

If we must have accounts, however, let us hav them in such a form as to give the maximum amoun of information about the running of the busines with the minimum of effort.

The author, who has had an extensive and varie farming experience, assumes no previous knowledg of bookkeeping on the part of his readers. Startin from first principles, he leads on through a serie of farm accounts posted by double entry, the example increasing in scope as the more intricate points ar illustrated. Thus the treatment of the farmer' personal expenses, produce consumed in the farm house and payments in kind to farm workers, ar discussed at some length. The interpretation o balance sheet and profit and loss account as a guid to management also receives attention.

For those who desire to keep their accounts i the simplest form consistent with accuracy an efficiency, the author proceeds to describe the single entry system using an account book of his own desig as an illustration.

A section on cost accounting follows. The autho shows how cost accounts give a clearer view of the situation in the various farm departments than the purely financial treatment can provide. Further, when handled in mass by experts, they can form a basis for moulding agricultural policy. The nature of the records necessary to build up these accounts is explained with illustrations of the appropriate forms, but it is admitted that the procedure is too exacting for most farmers whose business is not big enough to justify the employment of a clerk.

Information relating to business methods and procedure forms an important part of the book. Certain tables of weights and measures, and valuers scales of compensation are given, some of which might with advantage have been included in an appendix.

The financial accounts are presented in sufficient detail to be readily followed by a beginner.

e Molluscan Family Planorbidæ

Frank Collins Baker. Collation, revision and ditions by Harley Jones van Cleave. Pp. xxxvi+ 0 (141 plates). (Urbana, Ill.: University of inois Press, 1945.)

HIS important monograph, based on exhaustive anatomical research, was nearing completion at e time of the author's death in May 1942; the llation, revision and additions necessary before blication having been carried out by H. J. van eave.

Frank Collins Baker's researches on the anatomy d ecology of North American freshwater Pulmonata ve long been familiar to malacologists on both les of the Atlantic, and valued for their accuracy d originality of concept; while the publication ore than thirty years ago of his monograph on the ymnæidæ of North and Middle America established s reputation as one of the few authorities on the bject. The present work, to which he devoted uch time and labour during the last twenty-five ars of his life, will long remain not only a lasting emorial to the man and his work, but also a andard text-book and work of reference. It fully nfirms the importance of a study of the compara- ve anatomy of the soft parts of these molluscs as ving the only true key to a natural classification, r the shell cannot be relied upon entirely for this urpose, its characteristics often proving misleading n account of the presence of many cases of parallel evelopment. That certain features of shell morpho- gy, however, when used in conjunction with the natomical details of the body, are of importance in stablishing a satisfactory classification of the lanorbidæ is fully demonstrated both in the text nd by the many admirable illustrations.

In the compilation of the work, the author had xamined no fewer than 725 specimens representative f eighty-one species and races of the family; the umber of species examined being divided among ne four subfamilies as follows: Planorbinæ 19; egmentininæ 11; Helisomatinæ 41; and Planor- ulinæ 10. The wide geographical distribution of ne Planorbidæ and their economic significance as the ntermediate hosts of various disease-producing arasitic trematodes renders the intensive study of hese freshwater molluscs one of prime importance, nd one to which the work under review forms a aluable and authoritative contribution.

F. MARTIN DUNCAN.

he Economics of Advertising

y F. P. Bishop. Pp. 200. (London: Robert Hale, td., 1944.) 7*s*. 6*d*. net.

A GOOD general dictionary tells you that advertising simply means making a thing widely nown by circular, etc., but a scrupulously careful cientific handbook tells you that advertising means 'the process of notifying *or persuading* people without ersonal solicitation" (italics ours). The difference etween the two statements makes all the difference —notifying, yes, by all means; persuading, a much more hesitant yes. The kind of thing that bothers most eople about advertising, is the patent-medicine dvertisement that blurs the distinction between alliatives and cures, the advertisement for pills that ulgarly disfigures a lovely landscape, the window-dressing that induces people to buy what they do not need and cannot afford. Evidently advertising ouches psychology, ethics and æsthetics as well as economics. Of all this the author of this fine book is perfectly well aware. He promises to deal later on with "the various ethical and social problems raised by the practice of commercial advertising". In this volume he adheres to his purpose as indicated in the title. The book is packed with information and suggestions coming from one who is obviously master of his subject, who has lived it as well as studied it, and who helps the reader to form a judgment as to the immediate future of advertising.

Waveform Analysis

A Guide to the Interpretation of Periodic Waves, including Vibration Records. By R. G. Manley. Pp. xi+275+3 plates. (London: Chapman and Hall, Ltd., 1945.) 21*s*. net.

THE development of high-speed mechanical engines and similar devices has, during the last decade, brought forth a demand for both recording vibration amplitudes with accuracy and the analysis of such wave-forms as are thus obtained. The present author, while indicating methods of recording, is largely concerned with analysis, which is rendered complicated by the fact of frequencies which are not exact multiples. It is therefore necessary to extract beats and to endeavour to relate them to various other frequency components which are inherent in the wave-form. The precise analysis of the frequencies is essential in order that the source of the vibration component may be traced. It is important, therefore, that an exact record is taken simultaneously of any fundamental frequency of rotation in the machines being tested; but the author shows that variations in the actual speed of the record can be tolerated, provided this extra recording, as well as the time-scale, is also made. The author is to be congratulated on the completeness of his practical treatment, and the advice he has to give in interpretation; in particular, mechanical analysers are dealt with, especially that one devised by J. Harvey.

L. E. C. HUGHES.

Witchcraft in England

By Christina Hole. Pp. 168+16 plates. (London: B. T. Batsford, Ltd., 1945.) 21*s*. net.

THIS is an industrious and careful study of the voluminous records of various kinds of witchcraft and kindred practices, some of which survive to-day. The bibliography would have been more useful if dates of publication had been given throughout. The preliminary chapter on the "Art of Magic" follows Sir James Frazer's view that magic is "probably older than religion"; but doubt is cast on Miss Margaret Murray's belief in a "Witch Cult in Western Europe" transmitted from pagan times, though many rites and beliefs are of pre-Christian origin. The various forms of harmful magic are classified and illustrated in detail, with the ingenious and horrible methods of detecting witches within historic times, and the comparatively harmless practices of the 'white witch', which have survived the repeal of the statute against witchcraft in 1736 and the spasmodic panics, here and there, of later date.

As very few references are given, the result of so much labour is of no scientific value; and the more-than-Hogarthian illustrations by Merwyn Peake appear to be works of imagination. Only one has a place-name, but the church of Walton-in-le-dale does not look like that.

J. L. M.

CHEMISTRY OF PENICILLIN

THIS brief summary of results obtained by British and American chemists, issued under the joint auspices of the Committee on Medical Research (Office of Scientific Research and Development, Washington) and the Medical Research Council (London), is a preliminary notice of the principal findings secured up to the end of 1944 in a collaborative effort of a large number of investigators, unnamed at present. It implies some corrections of published data; authors of early publications are among those who have cleared up these points. For the sake of clearness, the account is not given in chronological order of development. The primary object of this communication is to disclose significant facts which have been confirmed by unequivocal synthesis and to record a few essential points which are still matter for conjecture. Full details will be disclosed at a later stage, together with an account of experiments not referred to in this report.

Several antibiotics of the penicillin class are known and all have the empirical formula $C_9H_{11}O_4SN_2R$. In penicillin-I (known in America as *F*-penicillin), R is Δ^2-pentenyl, $—CH_2.CH{=}CH.CH_2.CH_3$; in dihydropenicillin-I, R is *n*-amyl; in penicillin-II (known in America as *G*-penicillin), R is benzyl; in penicillin-III (also known as *X*-penicillin), R is *p*-hydroxybenzyl. In *K*-penicillin (a recent addition to the series) R is *n*-heptyl. The best elementary analyses are of pure crystalline sodium salts. Determinations of the molecular weights of the sodium salt and of the methyl ester of penicillin-II indicate that the empirical formulæ truly represent the molecular weights.

The penicillins are strong monobasic acids of pK about 2·8; electrometric titration does not disclose the presence of a basic group. Slow titration with perchloric acid in acetic acid solution indicates such a group, but the penicillin is biologically inactivated by this treatment; rapid titration gives a negative result.

The ultra-violet and infra-red absorptions, crystal structure (by X-ray methods including full electron distribution of the rubidium salt of penicillin-II), and polarimetric and polarographic behaviour of the penicillins and their derivatives have been studied.

Sodium penicillin-II contains one hydrogen atom replaceable by deuterium on equilibration with heavy water.

On treatment with hot dilute mineral acids the penicillins afford one molecule of carbon dioxide, an amino-acid termed penicillamine and other products. Penicillamine, obtainable by several other degradation processes, has been identified by analytic and synthetic methods as *d*-β,β-dimethylcysteine. Penicillamine with the same steric configuration is derived from penicillins-I and -II; it belongs to the *d*- or 'unnatural' series of α-amino-acids.

Synthetic penicillamine has been resolved and numerous derivatives of the optically active enantiomorphs and the racemic form have been prepared. These include penicillamine disulphide (tetramethylcystine) and penicillaminic acid (dimethylcysteic acid) as well as a long series of thiazolidines, and S- and N-substituted derivatives.

After removal of penicillamine from the acid hydrolysates, careful treatment of penicillin-I allowed of the isolation of an aldehyde, $C_8H_{13}O_2N$, in the form of its 2:4-dinitrophenylhydrazone and its condensation product with dimedone. Si ilarly, dihydropenicillin-I gave rise to derivati of an aldehyde, $C_8H_{15}O_2N$. Penicillin-II afford phenaceturic acid, phenylacetamide and an alc hyde, $C_{10}H_{11}O_2N$. Phenylacetic acid had pr viously been recognized as a hydrolytic product penicillin-II.

These *penillo-aldehydes* have been identified analysis and synthesis as follows: penillo-aldehyde- Δ^2-hexenoylaminoacetaldehyde; dihydropenillo- dehyde-I, *n*-hexoylaminoacetaldehyde; penillo-ald hyde-II, phenylacetylaminoacetaldehyde.

It was inherently probable that the carbon dioxi liberated when penicillin is hydrolysed in hot ac solution was derived from an unstable carboxyl grou and, taking into consideration the nature of penici amine and the penillo-aldehydes, a probable pr cursor was penillo-aldehyde-carboxylic acid, CHO.C (CO_2H).NH.COR, now termed a *penaldic acid*. Th was conclusively demonstrated to be correct.

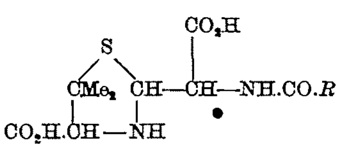
Penicillin-II and benzylamine afford a crystalli compound, $C_{30}H_{36}O_4N_4S.H_2O$, which has the con position of a hydrated addition compound of o molecule of penicillin-II and two molecules of benzy amine and is the mono-benzylamine salt of the mon benzylamide of a dicarboxylic acid. Degradation this substance by means of mercuric chloride afforde penicillamine and penaldic-II acid benzylamide whic was catalytically reduced to hexahydrophenylacety serine hexahydrobenzylamide, $C_6H_{11}.CH_2.CO.NH$ $CH(CH_2OH).CO.NH.C_7H_{13}$, identified with a syn thetic specimen.

The penicillins are readily inactivated by methan and the products are methyl esters. Methanol inactivated penicillin-II was degraded to methyl penaldate-II, $CHO.CH(CO_2Me).NH.CO.CH_2Ph$, th constitution of which was proved by its catalyti reduction to N-hexahydrophenylacetylalanine The latter was identical with a specimen prepare by similar reduction of phenylacetylalanine. Penicillins-I and -II are converted by the action of diazomethane into mono-methyl esters and these are degraded by mercuric chloride in aqueous solution wit formation of the methyl ester of penicillamine.

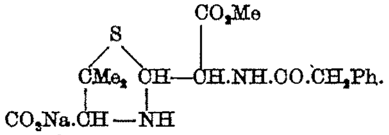
These observations serve to show (1) that the acidi group in penicillin is identical with the carboxy group in penicillamine, (2) that by the addition o the elements of water to penicillin a second carboxy group is produced, (3) that it is this new carboxy which breaks down to carbon dioxide by the actio of hot dilute mineral acids.

The dicarboxylic acid obtained by hydrolysis o penicillin at the site of the potential carboxyl i termed *penicilloic acid*. This acid is produced in the form of salts by treatment of penicillin with alkalis, and is presumably the product of the action of the enzyme penicillinase on penicillin.

Derivatives of penicilloic acid have been synthesized and the outcome of much work that cannot here be described in detail is that penicilloic acids are undoubtedly thiazolidines of the formula:



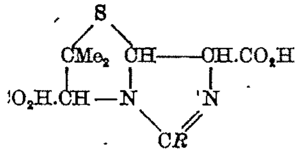
Where R is one of the groups already particularized. hus 'methanol inactivated' sodium penicillin-II is ne of the stereoisomeric forms of the structure:



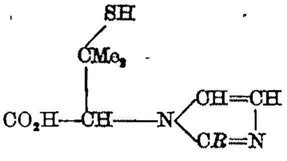
When any of the penicillins is held in dilute mineral cid solution at about 30°, a change occurs which may be followed polarimetrically. Crystalline isomerides of the penicillins termed *penillic acids* may then e readily isolated. These substances are shown by ectrometric titrations to be dibasic acids containing basic group: thiol groups are absent.

Treatment of the penillic acids with cold aqueous mercuric chloride involves loss of a molecule of arbon dioxide and formation of substances termed *enillamines*. These compounds are monobasic, mono-acidic and contain a thiol group.

Analysis and synthesis have shown that the annexed xpressions represent the respective structures

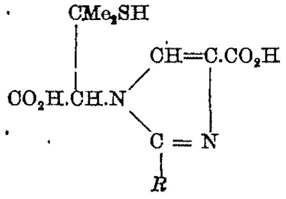


Penillic acids



Penillamines

Penillic-I and -II acids are convertible by baryta into the isomeric *iso*penillic acids.



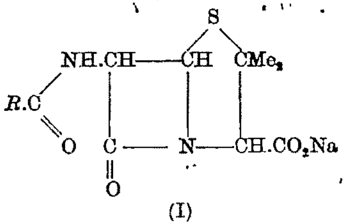
*Iso*penillic acids

Hydrolysis of the penillic acids by hot dilute acids affords penicillamine, the penillo-aldehydes and carbon dioxide; but the penillamines are resistant to hydrolysis.

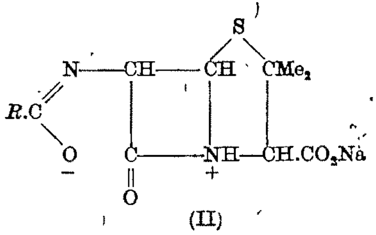
Methyl penicillin-II is changed by mercuric chloride n neutral media into the isomeric methyl penicillenate-II which, on hydrolysis by means of aqueous sodium hydroxide, affords the sodium salt of 4-hydroxymethylene-2-benzyloxazolone. The addition of the elements of thiocyanic acid to methyl penicillin, and the transformations of the primary product have been investigated in detail with important results.

Finally, the action of Raney nickel catalyst on sodium penicillin-II in aqueous solution affords desthio-penicillin-II, $C_{16}H_{20}O_4N_2$, together with phenacetyl-*l*-alanyl-*d*-valine, $C_{16}H_{22}O_4N_2$.

Naturally the workers in this field have formed views as to the full constitution of the penicillins. At present it can be stated that the formulæ which are now receiving the most active attention contain respectively a β-lactam structure (I) and an incipient azlactone grouping (II):



(I)



(II)

The following groups have participated in the joint programme for the chemical study of penicillin.

In Britain:

Boots Pure Drug Company, Ltd.*
British Drug Houses, Ltd.*
Cambridge University, Department of Chemistry.
Cambridge University, Department of Colloid Science.
Glaxo Laboratories, Ltd.*
Imperial Chemical Industries, Ltd. (Alkali Division).
Imperial Chemical Pharmaceuticals, Ltd.
Imperial College of Science, London, Department of Organic Chemistry.
The London Hospital Medical Unit.
Manchester University, Department of Chemistry.
May and Baker, Ltd.*
National Institute for Medical Research, Hampstead, London.
Oxford University, Department of Crystallography.
Oxford University, Dyson Perrins Laboratory.
Oxford University, Sir William Dunn School of Pathology.
Oxford University, Department of Physical Chemistry.
Wellcome Foundation, Ltd.*

In the United States:

Abbott Laboratories.
U.S. Department of Agriculture, Northern Regional Research Laboratory.
Cornell University Medical College, Department of Biochemistry and Russell Sage Institute.
Cutter Laboratories.
Federal Security Agency, Food and Drug Administration.
Harvard University, Department of Chemistry.
Heyden Chemical Corporation.
University of Illinois, Department of Chemistry.
Eli Lilly and Company.
Merck and Company, Inc.
University of Michigan, Department of Chemistry.
University of Michigan, Department of Physics.
National Bureau of Standards.
Naval Medical Research Institute.
Parke, Davis and Company.
Chas. Pfizer and Company, Inc.
The Rockefeller Institute for Medical Research.
Shell Development Company.
Squibb Institute for Medical Research.
The Upjohn Company.
Winthrop Chemical Company, Inc.

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* Members of the Therapeutic Research Corporation of Great Britain, Ltd.

AMERICAN WORK ON THE ATOMIC BOMB PROJECT

JUST as soon as it was discovered that secondary neutrons are liberated in uranium fission to the extent of considerably more than one for each heavy nucleus transformed, and that types of nuclei exist which undergo fission under bombardment with neutrons of all energies, it became a reasonable scientific guess that the attainment of a self-propagating (divergent) nuclear chain-reaction would eventually prove possible. So much was, in fact, commonly known by physicists in the late summer of 1939—and the implications of this knowledge in relation to the likely development of military weapons of extreme power were not altogether unheeded by scientific men whose countries were very obviously slipping helplessly into war. In the United States, also, attempts to arouse official interest in the new possibilities were not entirely without effect. By slow degrees this latter interest quickened, and a few weeks before the Japanese attack on Pearl Harbour, American service chiefs were ready to sanction a greatly intensified effort on the problem. Early in 1942 a full-scale research and development programme was under way and plans for pilot production plants were in hand. Almost exactly three years later, what had appeared in sober estimate so distant was an actuality; the first bomb had not been dropped, but the scientific workers in charge of the project were satisfied that success was well-nigh inevitable, and large production plants were rapidly accumulating the fissile material which it was planned to use.

As is well known, the crucial trial was not staged until mid-July 1945—and it was not until August 6 that the new weapon was used offensively; but earlier in the year the scientists' efforts had progressed so far that some of them at least were able to relax a little and look beyond immediate problems of physical research to the impact which the employment of the weapon would be certain to have on the world at large. The heads of the Allied States concerned in the development of the bomb would obviously find it necessary to issue statements setting out briefly what had been done and indicating their policy towards the enemy if he remained unsubmissive; but it was felt that the peoples of the Allied Nations could not be left without further information, and that a popular exposition was needed which would allow them to appreciate the magnitude of the scientific achievement involved and—always within the limits imposed by considerations of security—permit them to look into the future with some guidance in their certain bewilderment.

The American scientists who acted on these conclusions are to be congratulated on the results of their efforts, first in obtaining the support of the military authorities in whose hands the question of security was vested, and secondly on the popular account itself which has been issued by the Government Printing Office in Washington* (and has also been reprinted and published by H.M. Stationery Office in Great Britain†), having been compiled by Prof. H. D. Smyth, chairman of the Department Physics of Princeton University. This documen which was authorized for issue in America in Augus very soon after the attack on Hiroshima, runs t 182 pages. The author's preface is dated July 1945. The style is reasonably unhurried throughout the whole thing cannot have been written overnigh It is to be repeated that the foresight which con ceived the aim and scale of the report, and which le to its production, is greatly to be commended. I Great Britain we had less in the way of large-scal achievement to report upon, but it will be recalle that we also produced a 'popular' account for issue i August. The American account should be considere in one aspect, at least, in relation to the British on —to the necessarily incomplete but otherwise quit admirable White Paper* published by the Stationer Office. This is said in no spirit of criticism: it reflect merely the statement in Prof. Smyth's preface "References to British and Canadian work are no intended to be complete since this is written from the point of view of the activities in this country"

The American report is divided into thirteen chapters each with a summary, and there are fiv appendixes. The first chapter (twenty pages) and th first two appendixes ("Methods of Observing Fas Particles from Nuclear Reactions" and "The Unit of Mass, Charge and Energy") provide a backgroun of knowledge of fundamental nuclear physics t supplement the general scientific outlook which th reader of the report is assumed to possess—"[It] i written for this professional group . . . of engineer and scientific men who can understand such thing and who can explain the potentialities of atomic bombs to their fellow citizens". Chapters 2–5 giv the administrative history of the project in its various stages, Chapter 6 describes in general term the research carried out at Chicago in 1942, and Chapters 7 and 8 and 9 to 11, respectively, trace the development of the production methods used for plutonium 239 and uranium 235, the two fissile materials used for the bombs. The problem of bomb design and assembly is treated separately in Chapter 12, which gives a glimpse of the work of the special laboratory set up at Los Alamos precisely for this purpose. A short final chapter (13) summarizes the whole account—and ends with a call for an acute social consciousness to grapple with the weighty issues which the successful prosecution of the project has raised (Section 6, "Planning for the Future"; Sections 7 and 8, "The Questions before the People"). Lastly, Appendixes 3, 4 and 5 are included for the benefit of the semi-professional nuclear physicist. They give, as examples of the type of fundamental research work carried out in the course of the development programme, brief accounts of an investigation of the delayed neutrons of fission and of the construction and testing of the first self-sustaining chain-reacting pile (which was brought into operation on December 2, 1942, at an initial energy output of 0·5 watt)—also a representative list of eighteen titles taken from the index of reports written by the Chicago workers during 1942.

It will be evident from this brief digest of the contents of the Smyth Report that it cannot fail to make interesting reading. To the general reader the earlier chapters may appeal more than the later ones; the account of the administrative handling of this vast project will certainly be a revelation to the industrialist—it is without question the history of the most complex and extensive industrial project ever brought into co-ordinated operation within a period of little more than two years; it is also, by implication, the story how, in a country of free institutions, under the stress of total war, many hundreds of millions of dollars were expended and many thousands of persons were employed without Congressional sanction or knowledge ("Because of the restrictions of military security there has been no chance for the Congress or the people to debate such questions").

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* A General Account of the Development of Methods of Using Atomic Energy for Military Purposes under the Auspices of the United States Government, 1940–1945. By Prof. H. D. Smyth. Pp. vii+182. (Washington, D.C.: Government Printing Office, 1945.) 35 cents.

† Atomic Energy. (London: H.M. Stationery Office, 1945.) Pp. iv+144. 2s. 6d. net.

* Statements relating to the Atomic Bomb. (London: H.M. Stationery Office, 1945.) 4d. net.

To the scientist, however, the later chapters will probably have the greater appeal. Unless he has been associated with the project he will scarcely have heard of the 'transuranic' elements 93 (neptunium) and 94 (plutonium). To him, Chapters 7 and 8 will be particularly illuminating. He will be able to read for the first time a connected account of an altogether amazing achievement in transmutation. A chemical species which does not occur naturally on the earth, and for which the astrophysicist has never produced evidence of occurrence in the stars, has been manufactured on an industrial scale: kilograms—probably hundredweights—of uranium have been transformed, atom by atom, into something strange and new, and, as a by-product, energy has been released at a power which, if expressed in thousands of kilowatts, must certainly involve numbers which are large. He will be interested, too, to know something of the methods by which isotope separation has been achieved for the heaviest of the terrestrial elements—how many kilograms of the rare isotope uranium 235 (natural abundance 0·7 per cent!) have been separated, practically pure, by a bold development of the electromagnetic method, which before the War had been made to yield merely a few micrograms of the separated isotopes of lithium and boron for particular experiments (Chapter 11).

No one can possibly detract from the achievement of the scientists and engineers who brought this amazing project to success in the United States within days which were numbered; but a British reviewer may be pardoned for returning to the subject of the contribution which his colleagues belonging to this country made in the earlier (as to some extent, also, in the later) phases of the work. Let it be said, then, that the Smyth Report recognizes the reality of this contribution. It records the fact that a suggestion was made through the British scientific liaison office in Washington, late in December 1940, that plutonium 239 appeared worthy of serious consideration as material for a bomb (Chapter 3, Section 17), also that the definitive report of the Committee of the National Academy of Sciences dated November 6, 1941, was more conservative than the British report of July 15, 1941 (progressive action being taken on the former only in view of its reinforcement by the latter report; and because of "general urging by a number of physicists"—including Urey and Pegram, who had just returned from a visit to Britain: Chapter 3, Sections 21 and 23). It states quite clearly "The British, particularly J. Chadwick, were convinced that a U235 chain reaction could be achieved. . . . They feared that if the Germans got atomic bombs before the Allies did, the war might be over in a few weeks. The sense of urgency which Pegram and Urey brought back with them was of great importance" (Chapter 4, Section 47). More could scarcely be expected by way of acknowledgment from an ally and partner (if the reader wishes to learn more of the British effort he should consult the White Paper referred to above). In view of this, it is doubly unfortunate that a charge should be levelled against the "foremost nuclear physicist" of another ally, amounting, at the least, to an accusation of political unwisdom and irresponsibility. It would not appear that the section of the report in question (Chapter 3, Section 2) is factually correct, let alone temperate in utterance. This, however, is but one blemish in a generally admirable and objective presentation.

N. FEATHER.

PENICILLIN IN THE TREATMENT OF SYPHILIS

By DR. JAMES MARSHALL

IT is generally agreed that probability of cure in syphilis can only be assumed if, during five years after treatment, there have appeared no signs, clinical or pathological, of relapse or progression. Penicillin was first used in the treatment of syphilis as recently as 1943, and it is now known that the doses originally used were inadequate. We cannot, therefore, begin to estimate the value of penicillin as an agent for the permanent cure of syphilis.

It is possible, however, to describe the remarkable effects of penicillin on the lesions of syphilis at all stages and to give some indication of the short-term therapeutic results. Only the passage of time and careful observation of large numbers of cases treated by various methods will permit the place of penicillin in the treatment of syphilis finally to be evaluated.

Penicillin already bids fair to oust the arsenicals from their position as chief agents in the treatment of syphilis. It has one enormous advantage over arsenic, bismuth and mercury, in that it can be administered in any dosage without fear of dangerous toxic effects. (It must, however, be used cautiously in certain cases of late visceral syphilis for fear of therapeutic shock.) The immediate surface sterilizing action of penicillin in early contagious syphilis is profound and will doubtless have great repercussions in disease control in the future. One can predict that this advantage will, for a time at least, be offset by the fact that penicillin is already showing signs of producing a state of foolhardiness in those treated with it. Some patients with venereal diseases are already treating their conditions in the most light-hearted manner and repeatedly re-expose themselves to infection as soon as they think themselves cured. If penicillin were indeed a 100 per cent cure such people would harm only themselves; but, unfortunately, this is not the case.

Early Syphilis

The results of past experience allow certain generalizations to be made. It is not possible to cure human or animal syphilis by a single injection of penicillin no matter how high the dosage. Repeated injections are necessary. Intramuscular administration appears to give better results than the intravenous method, whether by multiple injections or by continuous infusion. Injections of penicillin in aqueous solution must be given every three to six hours. Penicillin does not penetrate into the cerebrospinal fluid; in spite of this, it is unnecessary to administer penicillin by the intrathecal route in neurosyphilis.

The original experiments on cases of early syphilis in the United States involved the giving of varying quantities of penicillin (60,000–1,200,000 units) divided into sixty doses injected intramuscularly every three hours for seven and a half days. Quite independent of the dosage, the immediate results were the same in all series. *Sp. Pallida* disappeared from surface lesions in an average time of twelve hours; lesions healed rapidly; and there was a rapid trend towards reversal of positive serological reactions.

Appraisal of results in patients treated with penicillin by these methods depends on the eventual appearance of evidence of relapse, clinical or serological, after some months. The indications are, however, that in the above dosage range, the lower the dosage the higher the relapse-rate. J. E. Moore[1] states that the indicated eventual early relapse-rate with a total dose of 60,000 units in seven and a half days is 100 per cent; with 300,000 units about 75 per cent; with 600,000 units about 40 per cent; and with 1,200,000 units about 15–20 per cent.

Variation of the time factor has also been studied. When doses between 600,000 and 2,400,000 units were given in thirty injections in four days, the results were not so good as when the same doses were given in sixty injections over seven and a half days. The results of further increasing the total time of administration are not yet known. It has been established that spacing injections at intervals of twelve hours is not satisfactory, but it is not known whether three- or six-hour intervals make any material difference.

These early results suggested that increased dosage of penicillin was likely to produce a further fall in the relapse-rate, and at present the standard dose of penicillin for early syphilis is 2,400,000 units given in sixty injections over seven and a half days. Experimental series are being treated with even larger doses. Very good results have been obtained in the United States in two small series of cases treated with penicillin (60,000 and 300,000 units) and 'Mapharsen' (320 mgm.) over eight days.

My own experience with penicillin in early syphilis in men, using a dose of 2,400,000 units, confirms the general impressions of other observers. *Sp. Pallida* disappeared from surface lesions, in my cases, in an average of nine hours, and serial observations showed an increase in motility of the organisms just before their disappearance or death. Surface lesions healed as rapidly as in cases treated with arsenic and bismuth. Positive serological reactions reversed to negative in about the same time as in cases treated with arsenic and bismuth by rapid methods. A transitory increase in positivity of serological tests or a rise into positivity was sometimes seen during treatment when serial blood tests were made. The results of sixty-seven cases followed for at least six months are shown below:

EARLY SYPHILIS TREATED WITH 2,400,000 UNITS PENICILLIN

Primary sero-negative = 17 (of which 2 relapsed)
" sero-positive = 38 (of which 4 relapsed)
Secondary = 12 (of which 4 relapsed)
Total = 67 (of which 10 relapsed)
Average time for positive serological tests to become negative = 1·9 months
Analysis of relapse cases: cutaneous = 5; muco-cutaneous = 2, serological relapse = 1; sero-resistance = 2.

The incidence of relapse in this series was so high that, as will be described, the method of treatment was altered. Later observations and information have shown that failure after treatment of early syphilis with 2·4 million units of penicillin alone occurs in 7–8 per cent or more of cases followed u for six months or longer.

Relapse after Penicillin Treatment

Failure of penicillin treatment of early syphilis usually manifested by (*a*) cutaneous, muco-cutaneous or mucous relapse; or (*b*) serological relapse; o (*c*) sero-resistance; but a few rarer phenomena hav been described.

(*a*) *Surface Relapse.* In most cases the surface lesion heal rapidly under treatment. Occasionally, howeve cases are seen in which the chancre fails to heal completely and later breaks down again. Oftener th chancre heals completely but reappears on th original site after a latent period and may be accompanied by other surface manifestations of syphili Sometimes relapse phenomena are entirely 'secondary in type, the primary lesion remaining healed. Ev dence of serological relapse often, but not alway precedes or accompanies surface relapse.

Relapse lesions are often small and discrete an may entirely escape the notice of the patient. The ano-genital area should always be closely inspecte at the routine follow-up examinations, as it is common site for relapse phenomena of the condylomatous type. The interval between the end of treatment and the appearance of surface relapse ha varied, in my experience, between 59 and 200 days with an average of 83 days.

(*b*) *Serological Relapse.* In successfully treate cases of early syphilis, positive serum tests revers to negative in two to five months. Serological relaps is diagnosed when serial quantitative serum test show an increasing titre of positivity following phase of negativity or of declining positivity.

(*c*) *Sero-resistance.* Sero-resistance is diagnose at the end of an arbitrary period of six months cases where serial tests have shown a maintaine level of positivity. In some cases no decline in positivity follows treatment; in others there is a declin to a lower level, which is maintained.

Among the rarer relapse phenomena can be mentioned neuro-recurrence[2], ocular and osseous relapse and the persistence of *Sp. Pallida* in surface lesion at the end of the treatment period.

The criteria used in the past in the differentiation between relapse and reinfection with syphilis will n doubt have to be revised, but in the consideration of difficult cases it is well to recall the advice o Dr. Harry Eagle[3]: "in the evaluation of a new therapeutic procedure any treated case in which dark-field positive lesions develop within one to two years must be adjudged a treatment failure unless the evidence for re-infection is overwhelming".

Combined Treatment with Arsenic and Penicillin

The results obtained in early syphilis with a treatment lasting only seven and a half days are quite remarkable, but even with doses of 2·4 million units an important percentage of early infectious relapses still occurs. This relapse-rate is higher, in my experience, than with the 'twenty-day treatment' with arsenoxide and bismuth.

With the view of evolving a treatment which would reduce the relapse-rate, I consulted Dr. F. R. Selbie, who has been engaged in parallel experiments with rabbit syphilis[4]. He was of the opinion that using only penicillin, a really high cure-rate might be attainable only at dosage-levels of 10 million units and more, and that the best line of experimenta proach in the circumstances was by combining senical and penicillin treatment.

As a speedy complete treatment was an essential r my patients, it was decided to combine a modified rm of intensive arsenotherapy with penicillin at e previous dosage level. In order to give an adeuate amount of arsenic and yet avoid so far as possible e toxic phenomena always associated with rapid rsenotherapy, the treatment evolved consisted in the dministration of 0·09 gm. 'Neohalarsine' (arsphenxide tartrate) or 0·06 gm. 'Mapharsen' on two days ut of every three to a total of fourteen injections twenty days. (Previous experience had shown this ethod of distribution of injections to be almost ncomplicated by toxic reactions.) The total amount f arsenoxide (840 mgm. 'Mapharsen' or 1,260 mgm. Neohalarsine') approximates to two thirds of the mount usually given in the 'twenty-day' arsenoxide reatment, and is the smallest quantity of arsenic, hich, given by a rapid method, might be expected lone to cure a reasonable percentage of cases of arly syphilis.

The results in seventy cases so treated and followed or at least six months are shown below.

ARLY SYPHILIS TREATED WITH 2,400,000 UNITS PENICILLIN AND ARSENOXIDE

rimary sero-negative	17		
rimary sero-positive	30	Relapse	0
econdary	16		
elapse sero-negative	2	Cases failing to show tendency to reversal of positive serological tests—0.	
elapse sero-positive	5		
Total	70		

Average time for positive serological tests to become negative = 1·5 months

In a later series of patients, in order to reduce the ime spent in hospital, the plan was changed and he arsenoxide part of the treatment was given in en daily injections, each of 0·06 gm. 'Mapharsen' or 0·09 gm. 'Neohalarsine'. The incidence of minor oxic arsenical reactions was increased slightly by he closer approximation of the arsenical injections, but no major toxic effects have so far been encountered.

More than two hundred cases have now been treated by one or other of these methods of combined therapy, and the results, so far, appear better than with penicillin (2·4 million units) alone or with the 'twenty-day arsenoxide treatment'. Only three cases of relapse, all muco-cutaneous, have been seen or notified. It is of particular interest that two of the three patients who developed relapse phenomena had previously been treated for syphilis (one with 2·4 million units penicillin, the other with neoarsphenamine and bismuth) and the combined treatment was given as a result of failure of the original treatment.

Late Syphilis

The osseo-cutaneous lesions of late syphilis heal rapidly under penicillin treatment, and I have seen good clinical results in cases of gummata of the testicles. Interstitial keratitis in late congenital syphilis reacts equivocally.

My own relatively small experience with cases of late and latent syphilis with persistently positive serological reactions (in spite of arsenical and bismuth treatment) does not suggest that penicillin, in the dosage now employed, is very effective in producing reversal.

The results of treatment of visceral syphilis are difficult to assess. It may be noted, however, that the penicillin treatment of three cases of arterial syphilis (two of aortitis, one of aneurysm of the femoral artery) has been effected without evidence of therapeutic shock. Penicillin treatment was started without preparation with mercury or bismuth, the only precaution being that in the first forty-eight hours the individual doses were of only 10,000 units each.

In cases of late syphilis I have always used penicillin in a total dose of not less than 4 million units (for example, 100 injections of 40,000 units in aqueous solution). I consider it advisable to consolidate this treatment of attack with a long-term treatment with bismuth, or arsenic and bismuth, according to the type of case, over at least six months.

Neurosyphilis

Although penicillin does not penetrate into the cerebrospinal fluid in demonstrable quantities during the penicillin treatment of syphilis by the methods described, there is no doubt of its effect in neurosyphilis of all types.

Nelson and Duncan[5] report excellent clinical and pathological results in ten cases of early syphilitic meningitis treated with 600,000–4,000,000 units in seven and a half to eleven days. My own experience has been the same. One of my cases of secondary syphilis with meningitis is interesting in that the original abnormalities in the cerebrospinal fluid had disappeared two months after treatment with 2,400,000 units penicillin, and the fluid remained normal six months later when relapse became evident in a rising titre of positivity of serological tests and in the appearance of a general enlargement of lymph glands.

Stokes[6] reports that abnormal cerebrospinal fluids in late syphilis are improved by penicillin in 74 per cent of cases, and that improvement is marked in 33 per cent. The commonest change is a drop in the number of cells and in the quantity of protein. Symptomatic improvement of varying degrees can be achieved in general paresis, tabes dorsalis, meningovascular syphilis, recent ocular nerve palsies, optic papillitis and papillœdema. It remains to be seen whether such changes, clinical or pathological, will be maintained.

The optimum dosage in neuro-syphilis is as yet undetermined. Under investigation in America at present are: (1) repeated courses of relatively small doses, for example, 1,000,000 units at intervals; (2) single courses of 2,000,000–6,000,000 units within eight to twenty days; (3) malaria plus 2,000,000–4,000,000 units of penicillin simultaneously; (4) malaria followed by penicillin.

My own scheme of treatment in neurosyphilis now consists in the administration of 4,000,000 units penicillin followed by consolidatory treatment with an arsenical (trivalent or pentavalent according to the type of case) and bismuth for at least six months. Immediate results, clinical and pathological, have been good and improvement has been maintained in all cases. The speed with which gross abnormalities in the cerebrospinal fluid reverse to negative after penicillin treatment is often spectacular.

Congenital Syphilis: Prevention and Treatment

Lenz, Ingraham, Beerman and Stokes[7] have reported on the treatment of syphilis during pregnancy and infantile congenital syphilis with penicillin. Only a small number of cases was studied, but there are indications that penicillin has good effects on mother and child in syphilis during pregnancy. Miscarriage, stillbirth and neonatal death can be averted, and infants are born apparently healthy.

Infants with congenital syphilis were given 28,600–34,200 units penicillin per kilo body weight, distributed in fractions at four-hour intervals over eight days. The results as shown by clinical and serological response and by X-ray observation of the bones were very good.

Platou and associates[8] have treated sixty-nine cases of infantile congenital syphilis with doses of 16,000–32,000 units penicillin per kilo distributed over seven and a half days with good symptomatic results. Of thirty-nine cases followed from four to twelve months, twenty-five remained apparently cured, nine were still sero-positive but progressing towards negativity, and five had relapsed serologically (of which two relapsed clinically). They recommend treatment with 40,000 units per kilo.

The few pregnant women I have treated for early syphilis have been given 2·4 million units penicillin and a standard ten-week course of neoarsphenamine and bismuth. Only one of the series has as yet come to term and she was delivered of a healthy child.

Treatment Reactions

Local pain, sometimes quite severe, may be caused by certain batches of penicillin. This may be due to impurities, and it has been noted that in such cases the penicillin powder is often a dark orange or brown colour. The therapeutic efficiency is not impaired.

Cutaneous eruptions of erythematous or urticarial type are sometimes seen during treatment but do not necessitate interruption of therapy. Shock, with pallor, sweating and rapid pulse, early in the treatment is sometimes seen. A few such cases have occurred in our series, but treatment was never interrupted. Such reactions may possibly be due to impurities in the penicillin.

An important and almost constant feature in cases of early syphilis is a fever, sometimes high, which begins about twelve hours after the first injection and lasts for twelve to twenty-four hours. This is probably a variety of Jarisch–Herxheimer reaction, as a transitory increase in cutaneous eruptions or œdema around the chancre often occurs at the same time. In the few cases of late syphilis we have treated, this febrile reaction has not been noted. American observers have, however, noted the occurrence of therapeutic shock (for example, transverse myelitis, convulsions) in patients with late syphilis of the nervous system, and advise a cautious start with reduced doses of penicillin in such cases.

Lloyd Jones[9] reports venous thrombosis as a complication in a series of cases treated with penicillin intravenously in large doses (up to 500,000 units).

Summary and Conclusions

Penicillin is an effective agent in the treatment of syphilis at all stages. The early results with the dosage schemes already used are encouraging, but final judgment must be deferred until a significant number of cases has been followed for a period of at least five years. There is some reason to believe that the relapse-rate in early syphilis is inversely proportional to the dosage of penicillin, so that a better cure-rate may be attained when larger doses are employed.

The use of aqueous solutions of penicillin necessitates the hospitalization of patients with syphilis. Until this difficulty is overcome, it must, for various reaso reduce very considerably the number of patients w can have the treatment. Progress in the study of effects of retarding media (for example, beesw peanut oil mixture) suggests that a method m soon be available for adequately treating syphilis w one or two injections of penicillin each day.

It appears that penicillin and the arsenicals ha a synergistic action when used simultaneously. Pen ing the results of large-scale controlled experimen and as a means of conserving penicillin, I wou advocate for routine use in early syphilis so method of combined therapy. For patients requiri a rapid complete treatment (for example, mercha seamen) the arsenoxide-penicillin treatment scribed above is suggested; for those who c attend as out-patients, a week's hospitalization 2·4 million units penicillin, during which time can begun a standard ten-week course of injections neoarsphenamine and bismuth.

Every case of late syphilis deserves individu assessment; but as a basic principle, I consider th penicillin should always be followed by a long-ter treatment of consolidation with a suitable arsenic and bismuth.

In conclusion, I must point out that my prese advocacy of combined therapy in the treatment syphilis does not imply that penicillin alone is i capable of producing a cure. The optimum treatme for syphilis is still undiscovered. Penicillin in larg doses or by different methods of administration m provide the answer. In the meantime, the combin tion of penicillin with other anti-syphilitic remedi deserves further investigation.

[1] Moore, *Amer. J. Syph.*, **29** (March 1945).

[2] Leifer, *J. Amer. Med. Assoc.*, **126**, 67 (1944).

[3] Eagle, *J. Amer. Med. Assoc.*, 553 (Oct. 28, 1944).

[4] Selbie and Simon, *Brit. J. Exp. Path.*, **25**, 229 (1944).

[5] Nelson and Duncan, *Amer. J. Syph.*, **29**, 141 (1945).

[6] Stokes, Beerman and Ingraham, "Modern Clinical Syphilolog (3rd edit., 1944).

[7] Lenz, Ingraham, Beerman and Stokes, *J. Amer. Med. Assoc.*, **12** 408 (1944).

[8] Platou, Hill, Ingraham, Goodwin, Wilkinson and Hansen, *J. Am Med. Assoc.*, **127**, 582 (1945).

[9] Lloyd Jones, paper read at Med. Soc. for Study of V.D., Londo (March 1945).

OBITUARIES

Prof. J. T. Wilson, F.R.S.

James Thomas Wilson, emeritus professor o anatomy in the University of Cambridge, died o September 2 at the age of eighty-four years.

An Edinburgh graduate and a pupil of Sir Willia Turner, Wilson went to Australia as a demonstrato of anatomy in the University of Sydney when he wa twenty-six years old; three years later, independen chairs of anatomy and physiology were created an Wilson was elected as the first holder of the Challi professorship of anatomy. This position he held fo the next thirty years, during which time he built u a fine department, a tradition for thoroughness i scientific investigation, and a great reputation as university administrator of sound judgment and wit an unusual breadth of vision. He was dean of th Faculty of Medicine, and, among many interests and responsibilities outside the University, he served with distinction in the Australian Intelligence Corps, being promoted honorary colonel in 1915.

During this period, Wilson collaborated with Sir arles Martin and, more particularly, with Prof. P. Hill in research work, as a result of which many pers of fundamental importance were published on e structure and development of monotremes and arsupials. The late Sir Grafton Elliot Smith was e of his earliest pupils, and there is no doubt that ilson's guidance and stimulating influence must ave counted for much in laying the foundations for s later brilliant work.

In 1920, Wilson accepted the chair of anatomy at ambridge. Although a comparative stranger, his utstanding abilities were quickly recognized, and he ined the respect and affection of all who worked ith him in the University, and of the society of St. ohn's College, where he was elected to a fellowship the same year. His work for the Cambridge natomy School is well known. During his fourteen ears tenure of office, he enlarged and reorganized e course in anatomy for Part I of the Natural ciences Tripos, created an excellent departmental brary to which he gave a great part of his private ollection of books and papers, and attracted each ear a small number of students to take anatomy in art II of the Tripos.

Wilson's scientific work was always characterized y meticulous care and thoroughness, and his papers ere models in their exactness of expression and ucidity. The value of his contributions to natural cience was recognized by his election into the fellowhip of the Royal Society in 1909. In his later years, while at Cambridge, he spent a considerable part of is time in perfecting a technique by means of which series of sections of large embryos could be exploited o the greatest advantage; the enthusiasm which he howed in the development of the method, and in the lemonstration of his specimens to those immediately round him, was wholly characteristic; it is a great oss to embryology that but few of the many critical nd original observations which he made as a result were published.

After his resignation from the chair at Cambridge n 1934, he continued to lead a full and active life; that his judgment was held in the highest esteem to the end is evidenced by the fact that this year, at the age of eighty-four, he was asked to continue his Carnegie Reports for a further year. He was the first overseas member of the Anatomical Society of Great Britain and Ireland, and he acted as its president during the years 1922–24.

This record of scientific and administrative achievement alone would place Wilson high in the ranks of great medical teachers, but his greatness and influence were more profound and far-reaching than can be indicated by a mere statement of facts. His personal example and his friendship had a marked and lasting effect on generations of students; medical men who were trained at Sydney during Wilson's time still say, when his name is mentioned, "Oh, you mean Jummy", and go on to speak of him with a spontaneous fervour delightful to hear. He had great charm of manner and a natural power of inspiring those around him; he was actuated by the highest ideals, the sincerity of which was recognized and appreciated by the members of his staff and by his students. As with his scientific work, thoroughness and enthusiasm permeated every aspect of his teaching; he gave without stint of his time, knowledge and experience, and no one could fail to be the better man for having met and worked with him.

H. L. H. H. GREEN.

Prof. W. H. Fraenkel

THE death occurred on July 14, 1945, of Prof. Walter Fraenkel, who was living at Perth Amboy in the United States. He had been expelled from Germany early in 1939 by the Hitler Government and, after spending nearly a year at the University of Cambridge, as guest of the Metallurgical Laboratories, emigrated with his family to the United States.

Fraenkel's work covered problems of the age hardening of aluminium alloys, diffusion, segregation and crystallization and chemical reaction between metal and slag; the latter in close co-operation with R. Lorentz. Fraenkel held a professorship in Frankfurt-am-Main and there most of his research work was done, with the help of a small band of enthusiastic and devoted pupils.

Two short periods in industrial research during the First World War and in the thirties gave him an opportunity of learning about industrial problems and the industrial way of technical development.

Prof. Fraenkel was a physical chemist (trained under Bredig and Lorentz) and his approach to problems of metallurgy was always from this angle, as was the method of his teacher in this field, Tammann. He even introduced the kinetics of reaction into metallurgy in his work on the age hardening of duralumin, a problem which fascinated him during almost the whole of his research work. His studies on this subject were among the earliest scientific work done on this important theme.

I happened to be the first student who chose a subject in Prof. Fraenkel's own line of research for a thesis. The work was carried on in closest collaboration with him. He knew and watched every step and, in long and almost daily discussions, an intimate view of the man and his work was obtained, and also no small inspiration from his general attitude towards science and scientific work. His rigorous criticism of any results, be it his own or other workers, without regard to name and reputation, his modesty and his complete devotion to the cause of truth and science, were among his outstanding characteristics.

In spite of the almost pessimistic severity of his general outlook and many personal disappointments, Prof. Fraenkel possessed a keen sense of humour and a caustic wit that spared nobody, least of all himself. All his pupils and his colleagues will honour his memory as that of a man of high principles, a most capable and careful man of science and teacher and a kind and reliable friend.

E. SCHEUER.

Dr. William Cramer

WILLIAM CRAMER was born in the Rhineland on June 2, 1878. After taking his Ph.D. at the University of Berlin in 1901, he worked in its department of pharmacology. There he met E. F. Bashford, and their friendship resulted in his joining the staff of the Imperial Cancer Research Fund in 1903. Thus he came to collaborate with Bashford and Murray in that pioneer work which contributed so much to our knowledge of the growth of cancer under experimental conditions.

In 1905, Cramer went to Edinburgh as lecturer in chemical physiology in Sharpey-Schafer's Department, and took the degree of D.Sc. three years later. He published "Directions for a Practical Course in Chemical Physiology" in 1912, which ran to four editions. His position as a university teacher became somewhat difficult on the outbreak of the First

World War, and through the good offices of Dr. J. A. Murray, then director of the Imperial Cancer Research Fund, he rejoined its staff. Back in London, he completed his medical studies at University College Hospital and took the diplomas of M.R.C.S., L.R.C.P. in 1917. His intellectual versatility and wide scientific interests found expression in the numerous papers he published between 1915 and 1939, which embraced almost every aspect of the cancer problem. Never slow himself to enter the realm of scientific speculation, he protested only last year against a tendency in cancer research "to exalt theories over facts, to make facts fit into the Procrustean bed of a theory". He was specially interested in the hormonal factor in cancer, and a by-product of his investigations in this field was the book he published in 1928, entitled "Fever, Heat Regulation, Climate and the Thyroid-Adrenal Apparatus". He retired from the Imperial Cancer Research Fund at midsummer 1939.

After taking part in the Seventh International Genetical Congress in Edinburgh in August 1939, Cramer journeyed to America for the Third International Cancer Congress. Afterwards he joined t research group which Prof. E. V. Cowdry of St. Lou University organized at the Barnard Skin and Canc Hospital for a special investigation into epiderm carcinogenesis. He became chief pathologist to t Hospital, and in 1941 delivered the Middleton Gol smith Lecture to the New York Pathological Societ

Cramer died in Denver, Colorado, in August la a victim of the disease to the study of which he h so assiduously devoted the greater part of his li

R. J. LUDFORD.

WE regret to announce the following deaths:

Sir Edward Farquhar Buzzard, K.C.V.O., emerit regius professor of medicine, University of Oxford, December 17, aged seventy-three.

Dr. E. W. Kemmerer, the well-known internatio economist, formerly professor of economics a finance in Princeton University, on December 16, ag seventy.

NEWS and VIEWS

Royal Institution: Appointment of Prof. E. K. Rideal, F.R.S.

As recently announced, Prof. E. K. Rideal relinquishes his post as professor of colloid science in the University of Cambridge to succeed Sir Henry Dale as Fullerian professor of chemistry in the Royal Institution and director of the Davy Faraday Research Laboratory. Prof. Rideal's great breadth of scientific interests and achievements, so befitting his new position, must have received considerable stimulus from an unusually varied career. A scholar of Trinity Hall, Cambridge, he graduated there in 1911. Upon the outbreak of the First World War he joined the Royal Engineers and was later invalided from France to the Munitions Inventions Department. During 1919–20 he was visiting professor of physical chemistry at the University of Illinois, and afterwards returned to Cambridge as Humphrey Owen Jones lecturer in the Department of Physical Chemistry.

In 1930 Rideal was elected a fellow of the Royal Society; and the University of Cambridge, assisted by a grant from the International Education Board, set up a Department of Colloidal Physics with Rideal as its first professor. Shortly after, the Plummer bequest enabled the original temporary professorship to be consolidated, and the Department became the Department of Colloid Science, its objects being the study of the physics and chemistry of colloids and their application to biology. Under his guidance a small but enthusiastic nucleus concerned themselves chiefly with the study of insoluble monolayers and catalysis by solid surfaces, laying the basis for a reputation which was soon to become international. The Department grew steadily in numbers; by 1939 it housed some twenty-five research workers, the variety of nationalities represented being paralleled by the diversity of activities, which had by now spread quite naturally into the field of high polymers. To all, however complex the problem, Prof. Rideal's stimulating discussions and detailed personal interest were a never-failing source of inspiration.

War brought inevitable changes in its train. Langmuir troughs were set aside and more urgent problems taken up at the request of Government and Service Departments. This entailed innumerab committees and considerable travelling; but despi enforced absences, Prof. Rideal still gave his usu courses of lectures and showed an almost uncann acquaintance with the details of the by now incredibl mixture of activities housed in his Department. H inspiration and optimism, which never visibly faile are familiar to all who met him in those days. Th return of peace saw the Department's numbe standing at thirty-five, an acute problem of accom modation but a testimony to his war-time leadershi His many friends in Cambridge and elsewhere, an that widely spread body of his past pupils, will joi in expressing their great pleasure at his appointmen and will wish him every success in his new field o activity.

Chemical Engineering at the Imperial College: Prof. D. M. Newitt, F.R.S

PROF. D. M. NEWITT has been appointed to th Courtaulds chair of chemical engineering in th Department of Chemical Engineering and Applie Chemistry, Imperial College of Science and Technology, London. The recent munificent gift to th Imperial College by Courtaulds, Ltd., has mad possible the establishment of this chair; a trust ha been set up to administer the funds, which amount t about £118,000.

Prof. Newitt has been associated with the Department of Chemical Technology at the Colleg since 1920, where he studied under Prof. Bone an Dr. Hinchley, who was then in charge of the chemica engineering section of the Department. For man years Prof. Newitt acted as one of Prof. Bone's chie assistants in researches on combustion, being particularly associated with the work on explosions a high pressures. This led him to his well-know studies of the behaviour of materials at extrem pressures up to 20,000 atmospheres, for which skil and originality in engineering design and specia knowledge of the properties of highly stressed materials were required. In the development of industrial processes operating at high pressures he ha been able to give most valuable advice, and he ha ontributed to advances in the design of compressors nd of vessels to withstand high pressures. During he War, Prof. Newitt was in charge of the research work of the Inter-Services Research Bureau and was esponsible for many important developments. He s a member of the Heyworth Committee on the gas ndustry which has recently reported. He has also ecently had the opportunity of visiting schools of hemical engineering in the United States of America. Prof. Newitt combines experience of research work n a wide field of engineering and physical chemistry with teaching experience which augurs well for the School of Chemical Engineering at the Imperial College.

Card File of Physical Constants of Substances

THE general plan of the American "Annual Tables of Physical Constants", started in 1941 under the National Research Council, called for publication of tables on loose sheets, by sections according to properties, and also of a card file of numerical data of physical magnitudes, by substances. The card file represents a departure from the customary method of recording and filing data dispersed in the literature. They are to be assembled in the card file for each substance in a permanent predetermined order of physical properties, instead of being tabulated for each property, for a list of substances. Thus all physical properties for a given substance are brought together, adding up to a complete numerical description of the substance; and the non-availability of certain data for the given substance becomes immediately noticeable by the absence of the section number of the corresponding property on the substance chart. The actual numerical values are inserted whenever they are expressible by a figure or a few figures; extensive tables of data are not as a rule reproduced. It is expected that microfilm distribution facilities and reading devices will be available in the near future, so that one may obtain microfilm copies of any scientific publication desired. This will render extensive reproduction of voluminous tables superfluous and further justify the present scheme.

The cards are being planned as follows: Elements in the alphabetical order of their symbols, inorganic compounds in the alphabetical order of their formulæ, organic compounds also in the usual order of their overall formulæ by increasing numbers of the carbon and hydrogen atoms. However, as the data are on loose cards, users, if they choose, can re-order their card files by any other principle which they may prefer. As new numerical material is published, additional cards will be issued for substances already covered. Likewise revised cards will be supplied whenever necessary to replace old cards which may become obsolete. It is planned to issue about two thousand substance cards a year in instalments of a hundred cards. One drawback of the use of the small-sized card, 5 in. × 3 in., is that it may involve a large number of cards per substance; for example, bromine requires eighteen cards. The subscription price is based on the rate of 5 cents a card, that is, 100 dollars a year for a set of 2,000 cards. Auxiliary cards will be supplied at 1·5 cents a card or 5 dollars for the set, whichever is the less. Publication at practically nominal prices has been made possible by grants and subsidies provided mainly by industrial corporations and a generous donation from the Carnegie Institution. Correspondence should be addressed to "Annual Tables of Physical Constants", Frick Chemical Laboratory, Princeton, New Jersey.

The Association for Planning and Regional Reconstruction

IN response to many requests, the Association for Planning and Regional Reconstruction has decided to develop its Information Service, and subscribers are now to be offered, in addition to copies of all the Association's broadsheets and reports and the services of the library and the information bureau, a bi-monthly bulletin containing a report of work being undertaken by the Association as well as a résumé of matters of interest in the planning world and pre-publication news of books produced by the Association to ensure subscribers being able to obtain these when published. The first information bulletin, October–November 1945, continues as No. 160 the progress sheets issued since February 1941. The bulletin includes a selected list of recent acquisitions to the Association's library, and a revised edition of Broadsheet O, dated September 1945, giving general information about the Association and containing a complete list of broadsheets issued to date, has also been published. The Association, which aims at serving as a centre for research in the planning field and undertaking factual investigations, as well as acting in an advisory capacity and furthering the establishment of technical and other standards, and the development of new conceptions of planning, works closely with the School of Planning and Research for Regional Development, which is under a separate board of management. The School has enrolled more than a thousand correspondence students in the Armed Forces and among prisoners of war, and those who on demobilization reach a certain standard are eligible for a three months completion course, the successful students in which will be exempt from the final examination of the Town Planning Institute.

Training of Engineers

IN his presidential address before the Institution of Mechanical Engineers, delivered on October 19, Prof. Andrew Robertson emphasized that the training of engineers is concerned very much with "a knowledge of science and the technique which must go with it", to which must be added qualities of character. The needs of a healthily advancing industry show that mechanical engineering can usefully absorb a considerable increase (twice the pre-war number is suggested), in the output of universities and technical colleges, of young men trained to the standards of engineering degrees or of higher national certificates. "There is a definite field for the technical college distinct from that of the faculty of engineering," the range of activity of the former being from crafts at one end to higher national certificate and specialized technological work at the other. "The aim of a university department should be to produce potential leaders of the profession."

National certificate courses, successfully begun twenty-four years ago, should be further developed; part-time day release should be encouraged; opportunities for superior technical college students to attend full-time courses should be provided; the universities and industry should co-operate intimately in the production of scientifically trained men, not omitting college apprentices; engineering faculties should consider the advisability of instituting 'general honours' and 'special honours' degrees; the educational scheme of Britain should be so designed that at every stage promising students may be transferred to the course best suited to them; "there is a real need for an extension of post-graduate work both in research and in specialised studies in the fields of technology and administration, for established technical staff and executives"; some advanced students might with advantage work in the laboratories of the research associations. These and many other valuable suggestions are ably dealt with by Prof. Robertson in his discussion of engineering as a basis of a liberal education.

National Maps of Britain

A CIRCULAR from the Ministry of Town and Country Planning directs attention to a new series of maps of Great Britain constructed to illustrate various aspects of national life and resources. The scheme is a development of the idea of a National Atlas originally prepared by a committee of the British Association in 1939 and is now under the guidance of both the Ministry of Town and Country Planning and the Department of Health for Scotland. The maps are being published by the Ordnance Survey. All maps are to be on a scale of 1 : 625,000, or about ten miles to an inch, and all will bear the new national grid. Each map will be in two sheets, covering respectively (1) Scotland and the northern part of England and (2) the remainder of England and Wales. Those sheets already published are the base map, land utilization, administrative areas, topography, population density in 1931, types of farming and land classification. Several of these are new compilations. Shortly to be ready are sheets showing population of urban areas in 1938, roads, coal and iron resources, and iron and steel production. Others in hand include a physical map, with accepted terminology of physical features, grasslands of England and Wales, geology, electricity supply, gas, railways, population changes, various economic maps, and seaports. The price of the published sheets is generally five shillings.

Colorado Beetle in England during the War

THAT the freedom of the potato crop in England from the ravages of the Colorado beetle during the War was due not to good fortune but to the vigilance of the Ministry of Agriculture is evident from an article (*Agriculture*, 52, p. 210) describing the infestations that have occurred in various parts of the country in recent years. Since the outbreak at Tilbury in 1933 (which was only the second recorded in Great Britain) a close watch had been kept on potato crops, particularly in coastal areas. During 1936–39 a few beetles were reported in soils along the south-east coast and on ships in port, and, when military traffic across the Channel started, the precautionary measures were intensified. In 1941, however, beetles were discovered at six separate localities in the west of England, three of them being on inland farms in Devonshire. The special methods adopted for exterminating the pest were increased publicity and inspection, precautionary spraying of crops within a five-mile radius of an outbreak, and the restriction of potato growing to fields which had carried the same crop in the previous year. Approximately 30,000 acres of potatoes were inspected, beetles being discovered at five localities in the south-west counties in 1942. One further outbreak occurred in Wiltshire in the following year, and since then no infestations have been reported, though a few beetles were discovered on vessels and aeroplanes of cross-Channel services. The pest has evidently not yet established itself in Great Britain; but growers are asked to keep a constant watch and notify the Ministry at onc of any circumstances which arouse suspicion tha the beetle may be present. Unauthorized sprayin is strongly discouraged as it may cause the beetle to spread.

Use of Fertilizers in Britain

THE need for maximum food production in Grea Britain during the War called for the highest efficiency in the use of what fertilizers were available, and it i generally agreed that a drive for still further im provements must be made in the future if agricultur is to be put on a sound footing. In "Fertilizers Durin the War and After" (Pamphlet No. 13. Bath and West and Southern Counties Society. 2*s*.), Dr. E. M Crowther gives a comprehensive and most lucic survey of the subject, which will both be a valuabl guide to all concerned with crop production, and also of considerable historic interest. After comparing the pre-war consumption of fertilizers in Great Britain with that of neighbouring European countries and the United States, it describes the war-time rationing scheme for England and Wales, discusses the basis upon which it was founded and shows how the experience from large-scale field experiments has been utilized. It is impossible to give an adequate picture of the range of subjects dealt with, but among the newer aspects mention may be made of fertilizer placement. Results from field trials indicate that labour may be saved and the efficiency of fertilizers increased if small amounts of well-prepared fertilizer are placed in definite positions near the seed at the time of sowing. Another development that may well occur in the future is in the use of standardized compound fertilizers, which have proved so successful during the War. As regards the fertilizers themselves, Dr. Crowther considers that the technical efficiency of both making and using phosphate fertilizers needs to be improved, and he puts forward a plea for some revision of the Fertilisers and Feeding Stuffs Act Regulations, so that full advantage may be taken of current and future research.

The Tata Memorial Hospital

AMONG the buildings of Bombay the strikingly modern design of the Tata Memorial Hospital for the treatment of cancer and allied diseases must stand out with a distinctness which will direct attention to the beneficence of its purpose. Founded by the trustees of the late Sir Dorab Tata as a memorial to the philanthropy of Mr. J. N. Tata and his two sons, Sir Dorab and Sir Ratan, this fine hospital came into being in 1941 and has issued its first triennial report. Designed and built after consultation with experts from Manchester, London, New York, Cleveland, Paris, Stockholm and Brussels, the hospital is now staffed by Indian surgeons, anæsthetists, radiologists, pathologists and physicists, many of whom were sent abroad while the hospital was being planned and built, to gain special instruction and experience. The result is a hospital which can take its place beside any centre for the study and treatment of cancer, and it is not surprising that its superintendent, Colonel Sir J. N. Duggan, can report that it has, in spite of the handicaps of the war years, gained for itself a fine reputation. Any institution which can achieve, during a war like the one which has just ended, a standard of work like that which is here described, may congratulate itself. Future reports of its peace-time work will be awaited with interest.

Limitations of Science

In a paper "Methods of Research" (*J. Univ. Bombay*, **12**, March 1944, and **13**, March 1945), Prof. D. D. Kanga stresses the limitations of the scientific method in the modern world and the need for supplementing it, both in the world of affairs and in the sub-atomic world, by another training and discipline capable of transforming the present selfish, exploiting animal-man into a self-sacrificing, co-operating human being, willing to share with others. This technique Prof. Kanga terms the 'occult method', and emphasizing the importance of developing character, he believes that the chief drawback in our present system of education is the lopsided development of the individual. The university, he thinks, should address itself to this problem. In an earlier paper, "Knowledge Alone is not Enough to Solve our Problems" (*J. Univ. Bombay*, **12**, Part 3, November 1943), Prof. Kanga urged that it is the duty of a university to see that its curriculum provides for the development of its alumni equally from all sides; alongside science we require spiritual strength and spiritual qualities to enable us to resolve the many deadlocks confronting us in the world to-day.

Pitfalls in Prehistory

A short paper by Prof. C. van Riet Lowe of Johannesburg (*S. African J. Sci.*, **41**, 345; 1945) deserves to be noted by prehistorians elsewhere. It describes remarkable instances of artefacts transferred to surprisingly deep deposits by torrential river action; flaked pebbles from Carboniferous glacial gravels, betrayed by glacial striations; neolithic celts dispersed by a Norwegian settler in the last century; a soda-water bottle under 20 ft. of river-gravel; a wagon-wheel 23 ft. below a river bed, associated with a rolled palæolith; faked glass beads of German fabric, like those from Zimbabwe, reflecting a temporary fashion in amulets about 1908, and widely distributed in Transkei; a stone Chinese Buddha in undisturbed soil along the route of the Voortrekkers of 1837; and more Roman coins to add to those already known from various parts of South Africa and Rhodesia. The writer ends with an appeal to settlers, travellers, and field-workers not to discard any worked objects in situations where their presence may mislead.

Supernova in Canes

The June issue of *Sky and Telescope* contains a short reference to the discovery of a supernova in N.G.C. 5195, a satellite of the famous Whirlpool galaxy *M* 51. M. L. Humason was observing this satellite for the first time in three years, and on April 6 he noticed a faint star with which he was not previously familiar. The following evening he obtained its spectrum, which confirmed his suspicions that it was a supernova. At the time of discovery it had passed maximum by about 65 days. On April 12 the nova was at magnitude 16 photographic and 14 photovisual; its estimated maximum brightness was 11·0 photographic. It was fortunate that Humason had *M* 51 down on his observing programme on April 6, because the star was fading so rapidly that in a few weeks it would probably have been overlooked. A supernova appears in a spiral nebula on an average once in four hundred years, and this makes the coincidence all the more remarkable. In addition, the star would probably have escaped detection if it had not been so close to the central nucleus.

The Night Sky in January

New moon occurs on January 3d. 12h. 30m. U.T., and full moon on January 17d. 14h. 46m. The following conjunctions with the moon take place: Jan. 1d. 15h., Mercury 0·2° N.; Jan. 17d. 04h., Saturn 2° S.; Jan. 17d. 07h., Mars 2° N.; Jan. 24d. 11h., Jupiter 4° S. In addition to these conjunctions with the moon, Mars is in conjunction with Saturn on Jan. 22d. 17h., Mars being 4·4° N. Occultations of stars brighter than magnitude 6 are as follows: Jan. 12d. 17h. 39·1m., 147 *B* Aries (*D*); Jan. 14d. 01h. 57·8m., 85 H Tauri (*D*); Jan. 24d. 06h. 10·4m., 80 Virgo (*R*). The times are for Greenwich and (*D*) and (*R*) refer to disappearance and reappearance respectively. Mercury can be seen in the morning hours, rising at 6h. 25m. and 7h. 13m. at the beginning and middle of the month. Towards the end of the month the planet rises about the time of sunrise. Venus is too close to the sun during January for good observation, rising about 20 minutes before the sun on Jan. 1 and 15 minutes after the sun on Jan. 31. Mars, in the constellation of Cancer at the beginning of January, moving later into the constellation of Gemini, rises early in the evening and is well placed for observation throughout the night. The planet is in opposition with the sun on Jan. 14. Jupiter, in the constellation of Virgo, rises at 1h. 36m. on Jan. 1 and about midnight on Jan. 31. Saturn, in the constellation of Gemini, is visible throughout the night and does not set before the late morning hours. The earth makes its closest approach to the sun on Jan. 2. The Quadrantid meteor shower occurs during the first few nights of January.

Announcements

Prof. E. D. Hughes, professor of chemistry at the University College of North Wales, Bangor, will deliver the Tilden Lecture of the Chemical Society on January 17 at 5 p.m.

Mr. Paul G. 'Espinasse has been appointed lecturer and head of the Department of Zoology in the University College of Hull.

Standard Telephones and Cables, Ltd., have formed a central laboratory organization to undertake long-term research and development in the telecommunication, electronics and allied fields. The new laboratories, to be known as Standard Telecommunication Laboratories, Ltd., will be housed at Progress Way, Great Cambridge Road, Enfield, pending the erection of suitable permanent premises. They will have as their principal objective the intensification of research and development in all aspects of telephony, telegraphy, electronics, cables, radio, television, etc., and the various divisions of the Laboratories will be under the direction of specialists in the different spheres.

A Conference on "The Needs and Problems of the Family", arranged under the joint auspices of the British Social Hygiene Council and the Town and Country Planning Association, will be held at British Medical Association House, London, during January 24–25. Further information can be obtained from the Secretary, British Social Hygiene Council, Tavistock House North, Tavistock Square, London, W.C.1.

Erratum.—*Nature*, November 24, p. 626, col. 2, par. "British Bryological Society": *Dicranum strictum* is a recent addition to the flora of Surrey, not Britain as printed.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Determination of Factors Injurious to Plants in Acid Soils

Crop failures on acid soils are well known to farmers and to scientific workers interested in plant nutrition, and to both the remedy of liming is equally familiar. There exists, however, little knowledge concerning the relative importance of the various factors which produce the injurious effects observed on acid soils, and the subject is in need of intensive study. The evidence regarding the possible factors concerned are discussed by Russell[1], and it will suffice here to mention the main probable causes of injury: (1) direct injury of hydrogen ions; (2) lack of available calcium; (3) lack of available phosphorus; (4) excess of soluble aluminium; (5) excess of soluble manganese; (6) biotic factors (for example, mycorrhiza).

In examining crop failures, workers at Long Ashton have studied in particular the visual symptoms shown by plants in the field and in sand culture[2], and this technique has been applied during 1944 and 1945 to a detailed study of soil acidity effects on two plants the runner bean (*Phaseolus multiflorus*) and the cauliflower.

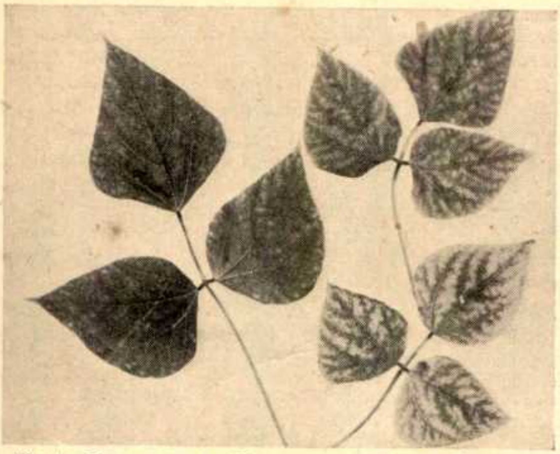

Fig. 1. Runner bean. High-manganese treatment. Comparison of manganese toxicity symptoms at high (left), medium (top right) and low (low right) calcium levels (June 18, 1945).

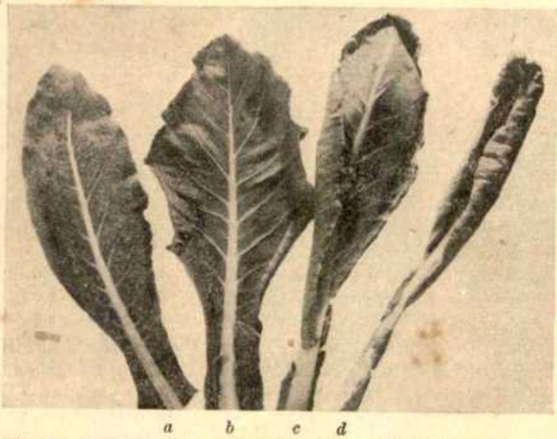

Fig. 2. Cauliflower. *a*, Calcium deficiency symptoms with low-(normal)-manganese. *b*, *c* and *d*, High-manganese treatment. Comparison of manganese toxicity symptoms at high (*b*), medium (*c*) and low (*d*) calcium levels. (July 6, 1945.)

In these investigations we have endeavoured to determine in sand cultures whether certain common and striking field symptoms are related to lack o calcium or to excess of aluminium or manganese, the *p*H being kept at a constant level throughout.

The results have shown that the characteristi 'field acidity' leaf symptoms of these crops, namely intervenal chlorosis and necrotic spotting of runne bean and incurled margins of cauliflower, are due to toxicity of manganese, though the toxicity effect are considerably modified by calcium status, being particularly severe when calcium is at a low leve and substantially decreased by a high calcium statu (Figs. 1 and 2). Using a plant-tissue test technique[3] as a measure of the solubility of manganese in the petioles, it has been shown that readily extractable manganese in the plant tissues is decrease by high calcium status.

The sand culture experiments were carried out according to a factorial design, using nutrient solutions with a constant *p*H of 5·2, with calcium, manganese and aluminium at the following levels. (Values are given as parts per million in the nutrient solutions.)

	Low (p.p.m.)	Medium (p.p.m.)	High (p.p.m.
Calcium	0	67	400
Manganese	0·3 (normal)	12·8	25·3
Aluminium	0·3 (normal)	5·5	11·0

As a basis to these experiments the true symptoms of calcium deficiency were determined in other cultures, where calcium was withheld and effects of manganese and aluminium were ruled out. In these it was established that the visual symptoms of calcium deficiency are as follows: *Runner bean*—leaves slightly pale green as for moderate deficiency of nitrogen, with necrotic spots, especially near tips and around margins, and progressing inwards intervenally. *Cauliflower*—young leaves distorted, with tips brown and sharply hooked either backward or forward; older leaves, marginal and intervenal areas become wilted and finally brown.

In the special experiments typical symptoms of calcium deficiency were developed in all the low-calcium cultures of runner bean, though in cauliflower the symptoms to date have only been slight, and no special leaf effects due to aluminium have so far developed.

In the medium and high-manganese series, however, the symptoms have been striking, the observations for the high-manganese series after five and seven weeks being summarized in Table 1.

Table 1. Severity of manganese toxicity symptoms.

Calcium level	Severity of manganese toxicity symptoms	
	23/5/43 (after 5 weeks)	7/6/45 (after 7 weeks)
Calcium *low*		
Bean	Moderate	Severe
Cauliflower	Trace	Severe
Calcium *medium*		
Bean	Slight	Moderate
Cauliflower	Nil	Slight—Moderate
Calcium *high*		
Bean	Trace	Slight
Cauliflower	Nil	Trace

Results of tissue tests made on June 7 and 15, after seven and eight weeks growth, are given in Table 2. They reflect clearly the increased amounts of extractable material of both elements according to the increased concentrations in the nutrient solution

TABLE 2. RESULTS OF TISSUE TESTS FOR CALCIUM AND MANGANESE IN PETIOLES.

Runner Bean (7/6/45).

Calcium level	Low			Medium			High		
Manganese level	Low (normal)	Medium	High	Low	Medium	High	Low	Medium	High
Element tested	Tissue test assessment								
Calcium	L+	L+	M−	M+	M+	M	H	H+	H
Manganese	Tr	H++	H++++	Tr	H+	H+++	Tr−	H−	H

Cauliflower (15/6/45).

Element tested	Tissue test assessment								
Calcium	L+	L	L	M+	M+	M+	H+	H+	H+
Manganese	Tr	H++	H++++	Tr	H++	H++++	Tr	H−	H+

H = High, M = Medium, L = Low; Tr = Trace.

and also the effect of high calcium status in lowering the amount of extractable manganese.

These results bring out clearly the importance of manganese toxicity in acid soils, a point also demonstrated for tobacco in Kentucky by Bortner[4], who showed further that the toxicity was decreased by phosphate treatments. They further emphasize the importance of the visual method as a means of diagnosis of the causes of crop failures due to defective nutrition, and of the sand culture technique as a means of analysing complex soil problems of plant nutrition.

The results of the investigations will be reported more fully at a later date.

The work has been carried out under special grants made by the Agricultural Research Council, to which grateful acknowledgment is made.

T. WALLACE.
E. J. HEWITT.
D. J. D. NICHOLAS.

Long Ashton Research Station,
Bristol. July 16.

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Measurement of the Diameters of the Living Eye by Means of X-Rays

SEVERAL of the pioneer workers in röntgenology—Rontgen included—recorded the fact that X-rays are perceived by the dark-adapted eye. Similar observations were made on radium rays, which were even held to surpass ordinary light as a source of illumination to the partially blind: radium rays were in fact used by one observer[1] for teaching at a blind school. Conflicting reports rapidly led to loss of all interest in the matter, until Taft[2] in 1932 clearly established the visibility of X-rays, and Pirie[3] simultaneously and independently directed attention to the possibility of 'reading with closed eyes' by means of X-ray light.

Possible applications to clinical ophthalmology were suggested by both these observers and by Gifford and Barth[4], and Newell and Borley[5]; while Rushton[6] in 1938 showed the axial length of the eye could be measured by throwing a beam of X-rays laterally on the posterior segment of the eye and moving this beam backward until its image became a point corresponding to the posterior apex of the globe. By noting the position of this point in relation to the image of the cornea reflected in a mirror, the axial length was obtained. Goldmann and Hagen[7] confirmed and extended this observation by recording the axial length of eighteen eyes.

The visibility of X-rays to the dark-adapted eye offers the opportunity of visualizing the shape and measuring all the diameters of the living eye. Such visualization and measurements can with advantage replace the 'schematic eye' (that is, a statistically computed average eye) in such practical problems as the localizing of intra-ocular foreign bodies and in the theoretical discussions on the nature and the varieties of the factors in the refraction of the eye.

Technique and findings. The subject undergoes fifteen minutes preliminary dark adaptation. He is then seated facing the X-ray apparatus in a darkened room with his head immobilized in a clamp. A slit beam of Rontgen rays, 0·5 mm. × 50 mm., is projected so that it traverses the eyeball with the plane of the beam at right angles to the diameter to be measured. This excites the sensation of vision where the beam transects the retina. By moving the beam from side to side without changing its direction with respect to the diameter and questioning the patient as to his visual sensations, it is possible to determine a position where the beam is tangential to the retina, that is, the position where the reported sensation is that of a point of light.

This position is marked by an exposure on a film introduced in front of the eye. The beam is then moved until it is again tangential at the opposite pole and its position again marked. On the developed film the distance between the two images gives the length of the diameter; thus any selected diameter can be measured provided its ends abut on the retina. As to the axial length, this is measured by determining the lateral projection of the posterior pole of the eye on a film by the method already described. A true lateral radiograph of the cornea is then taken on a dental film held at the inner canthus. A special cone is used carrying a cross-wire in its central ray, which impresses its image on both films. After development, the films are related to each other by superimposing the images of the cross-wire and the axial length measured between the corneal image and the slit image. With slight variations this technique can be employed in the localization of foreign bodies.

Dosage estimations show that, during the examination, no part of the skin receives more than 15 r.

and no part of the eye more than 7 r.—values well within safe limits.

The average anatomically determined measurements of the transverse, vertical and antero-posterior diameters of the eye are: 24·1, 23·5 and 24·2 mm. respectively[8]. There are, however, considerable individual variations. This is, broadly speaking, confirmed by the following X-ray measurements in five eyes:

Case No.	Measurements of diameters in millimetres Transverse	Vertical	Antero-posterior
1	23	22	23
2	23	21·5	26
3	24	23	25
4	22	21	22
5	24	23·5	24

In one case we had the opportunity of checking the X-ray measurements when the globe was excised for a malignant tumour. The X-ray measurements were 13 mm., 14 mm., and 22·75 mm. in the transverse, vertical and antero-posterior diameters respectively. In the excised eye the length of the antero-posterior diameter was identical with that obtained by X-ray measurement; low readings for the transverse and vertical diameters were found to correspond to the diameters formed by the inner and lower walls of the bisected eye with the apex of the tumour, which was situated in the upper and outer quadrant of the globe.

We are indebted to Dr. J. W. McLaren for advice and interest, and to Dr. G. Spiegler for the measurement of X-ray dosage.

ARNOLD SORSBY.
A. D. O'CONNOR.

Royal Eye Hospital,
London, S.E.1. Sept. 30.

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[3] Pirie, A. H., *Can. Med. Assoc. J.*, 27, 488 (1932).

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[5] Newell, R. R., and Borley, W. E., *Radiology*, 37, 54 (1941).

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An Induced Carcinoma in the Fowl

HOWEVER applied, or wherever injected, blastogenic agents, including tar and carcinogenic hydrocarbons, viruses and radium, usually induce in fowls mesoblastic tumours, that is, sarcomata or leukæmias. So far as we are aware, the only exception to this statement are the carcinomata which Japanese workers claimed to have obtained by injecting Scarlet Red and related azo compounds into fowls[1,2,3,4].

It is of some interest therefore that we have obtained a carcinoma of the kidney in a cock with another nitrogen-containing carcinogen, 2-acetyl aminofluorene. War-time conditions have prevented a repetition of the experiment on a larger scale.

Five one-month old Rhode Island Red cocks received 2-acetyl aminofluorene in the food for forty-five weeks; the daily dose commenced at 3 mgm. and was gradually increased to 30 mgm. at the end of the experiment (total 5·5 gm.). Three animals died during the first year but no tumours were found. The two survivors appeared healthy for about eighty weeks, when they began to lose weight. They were killed when they were moribund in the eighty-seventh week of the experiment, forty-one to forty-two weeks after the drug was withdrawn. In one of them the cause of death was a rather atypical leukæmia. T liver was grossly enlarged, weighing 367 gm. (quart of the total weight of the bird) and almost the ent liver tissue was replaced by immature blood cel The myelopoietic process affected the spleen (5·5 gm in much less degree, and the peripheral blood co tained relatively few immature leucocytes. It w impossible to decide whether the leukæmic proce was due to a virus or to the action of 2-acetyl amin fluorene, as the incidence of spontaneous leukæm in fowls is rather high.

In the other bird, however, the findings from th etiological point of view were less ambiguous. Bot kidneys were enlarged, especially the right (18 gm. and converted into irregular masses. The surfac were covered with whitish-yellow nodules togeth with several cysts, and on cutting the rather toug organs the nodules were found to replace the great part of the kidney tissue. Histologically, thes nodules were seen to be composed of polyhedr epithelial cells which were invading normal kidne tissue. The tumour bore no resemblance to the sc called embryomal nephroma and had all the char acteristics of an anaplastic carcinoma. Since suc a carcinoma is not known to arise spontaneously i the fowl, it seems justifiable to attribute its develop ment to the action of 2-acetyl aminofluorene.

Our thanks are due to Drs. W. E. Gye and E Vazquez Lopez for their opinion on the tumou morphology.

F. BIELSCHOWSKY.
H. N. GREEN.

Department of Pathology,
and Cancer Research Laboratories,
University of Sheffield.
Aug. 24.

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A Fatal Case of D.D.T. Poisoning in a Child

THE following is an account of what is possibly the first recorded human death from D.D.T. poisoning.

On August 22, 1945, an African child aged one year seven months and weighing 10 kgm. found a bottle of 5 per cent D.D.T. in kerosene, and drank (about) 1 oz. of the mixture. Within ten minutes he began to cough and vomit, whereupon he was given palm oil by the neighbours. His general condition became progressively worse, and after one and a half hours the child became comatose, and had convulsions which, so far as can be ascertained, consisted of generalized fine tremors. He was later seen by an Army medical officer, who gives the following account: "Child was comatose, collapsed with no perceptible pulse, froth at the mouth. Atropine, grs. 1/400 was given and the stomach washed out, the stomach washings proving to be a yellow pultaceous mass of paw-paw (native fruit). No smell of kerosene was detected. Artificial respiration was given but the child died at 15.00 hours", that is, four hours after ingestion of D.D.T.

Post-mortem performed two hours after death showed pulmonary œdema as the only demonstrable macroscopic lesion. The main histological findings ore a cloudy swelling of the liver and of the kidneys and a marked œdema of the lungs.

Full details of this case will be published elsewhere*.

K. R. HILL.
G. ROBINSON.

Medical Research Institute,
Accra, Gold Coast.
Oct. 1.

* See *B M J.*, Dec. 15, p. 845.—Editors.

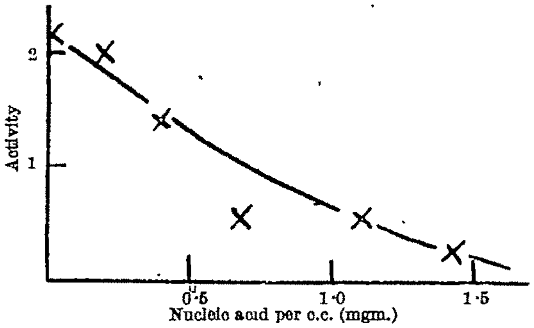
Adsorption of Enzymes on Solid Nucleic Acid

IN the course of experiments on an improved method for isolating and purifying the amylases of malt, I have found that solid yeast nucleic acid is a very powerful adsorbent of these enzymes. The figure shows an experiment in which varying quantities of the solid nucleic acid (B.D.H.) were added to diluted malt extract containing 0·12 mgm. nitrogen per mil, most of which is protein. The solution was gently shaken for a few minutes and then filtered. It can be seen that 1 mgm. of nucleic acid per ml. of solution removes the greater part of the enzymic activity. The enzyme can be recovered from the residue by the simple expedient of dissolving it in a few mils of dilute phosphate buffer of *p*H 6. For example, the following figures were obtained by the addition of 10 mgm. of nucleic acid to a malt solution containing 0·24 mgm. nitrogen per mil.

Activity in original solution	2 2
Activity in filtrate	0·6
Activity recovered from nucleic acid ..	1·5
Activity in wash water	0 2

The presence of nucleic acid in the solution appears to have no effect on the enzymic activity.

The malt extract used in these experiments contains both α- and β-amylases, but predominantly the latter. The activity was determined by adding 1 c.c. of the solution to 10 c.c. of 1 per cent soluble starch in a *M*/10 phosphate buffer of *p*H 6, for 10 (or 20) minutes at 37°, when the amount of maltose formed is determined by the method of Willstätter *et al.*[1]. This method determines primarily the β-amylase; but observations of the colour of the products with iodine indicates that the nucleic acid does not differentiate between the α- and β-amylases.



Compound formation between proteins and nucleic acid has been demonstrated in the past[2] by mixing solutions of protein and of nucleic acid and precipitating the complex with acid, and nucleic acid has been used in this way to precipitate enzyme as a step in purification[3]. I have not found any record of the observation of the reversible adsorption of enzymes on the solid acid. In view of the probable importance of nucleic acid in the processes of gene reduplication and protein synthesis[4], this phenomenon appears to be of considerable interest and is being further investigated.

I am much indebted to Mr. Adam Tait, of Messrs. Wm. Younger and Co., Ltd., for the gift of the malt.

J. A. V. BUTLER.

King's Buildings, West Mains Road,
Edinburgh, 9. Aug. 23.

[1] Willstätter *et al.*, *Z. physiol. Chem.*, 126, 143 (1923).

[2] Hammersten, *Biochem. Z.*, 144, 383 (1923). Przylecki and Grynberg, *Biochem. Z.*, 251, 248 (1932); 258, 79, 389 (1933).

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Inhibition of the Development of *Fusarium oxysporum cubense* by a Growth Substance produced by Meredith's Actinomycetes

IN a discussion which we had early this year with Dr. Portheim of Kew Gardens, the latter raised the question of the use of antibiotics in the control of plant diseases caused by bacteria and fungi, and suggested that preliminary work which he had carried out supported his contention that gliotoxin-producing fungi might be found useful in combating such diseases. Dr. Portheim's views would appear to have been in part substantiated by the recent observation of Brian and McGowan[1].

At the suggestion of Dr. Portheim, we undertook to determine the gliotoxin production of a culture of *Trichoderma viridans*, supplied by him, when grown on the waste water used in the cleaning of beer casks, a medium claimed by him to be suitable for the cultivation of this fungus. As test organism for gliotoxin production a standard strain of *Bac. subtilis* was used which, on trial, had been proved to be inhibited in its growth by gliotoxin, supplied by Dr. Portheim, in concentrations of 6 parts per million.

Though the culture of *Trichoderma viridans* used grows abundantly on the beer wash water at temperature between 25° and 30° C., at no time did the growth liquid have an inhibitory action on the development of *Bac. subtilis*; and it was concluded that, under the conditions employed, the *Trichoderma* culture had failed to produce gliotoxin.

When these experiments were in progress, we became acquainted with Meredith's[2] observation that certain Jamaican soils are inhibitory to the spread of Panama disease, caused by *Fusarium oxysporum cubense*, and that certain Actinomycetes inhabit such soils. On isolation and subsequent cultivation of these Actinomycetes in extracts from their own soils, some of these organisms were found by Meredith to inhibit or retard the development of *Fusarium oxysporum cubense*.

Though Meredith does not ascribe the function of his antagonistic Actinomycetes to growth-inhibiting substances produced by them, we felt it worth while to explore to what extent this might be the case, and in this way possibly to bring further evidence in support of Dr. Portheim's contention that certain plant diseases can be controlled by antibiotics. For this purpose we secured cultures of Meredith's Actinomycetes from the National Type Culture Collection and grew them on Portheim's beer wash medium and on the waste liquors resulting from food yeast manufacture.

In both these media the Actinomycetes grew well; in the latter particularly when the liquor was diluted with equal parts of water.

After incubation at 30° C. for one month, the inoculated waste liquor from food yeast manufacture was covered by a pink pellicle of Actinomycetes. When 4 ml. of this medium, freed from living cells by centrifuging, was added to 10 ml. of wort agar, the mixture allowed no growth of *Fusarium oxysporum cubense*, even when the plate was heavily inoculated with a fresh culture of the fungus. Wort agar plates which had had 3 ml. and 2 ml. of the centrifuged Actinomycetes growth-liquor incorporated allowed restricted growth of the fungus. Control plates made up of wort agar with 4 ml. of the original medium, on which the Actinomycetes was to grow, showed abundant growth of the *Fusarium* within two days.

After five weeks growth in food yeast waste liquor, the concentration of the inhibitory substance produced by Meredith's organism had increased to such an extent that 1 ml. of the liquor sufficed to prevent growth of *Fusarium oxysporum cubense*.

Having established the toxic action of Meredith's organisms, preliminary attempts were made to isolate the active substance. These attempts, so far, have shown that the substance is thermolabile and that it fails to pass through a porcelain filter.

Further investigations on its action, its isolation, and its nature are in progress.

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[1] Brian, P. W., and McGowan, J. C., *Nature*, 156, 144 (1945).

[2] Meredith, C. H., *Phytopath.*, 34, 426 (1944).

Insecticidal Properties of *Euphorbia* Extracts

IN the June number of the *Tropical Diseases Bulletin* (p. 502) there is a review of a paper by Mülhens[1] on the insecticidal properties of *Euphorbia dendroides* in Crete. I thought it might be desirable to place on record some tests on the insecticidal properties of *Euphorbia tirucalli* Linn. which were carried out during 1943 and 1944 in Tanganyika.

This, with other species of African *Euphorbia*, have been used for centuries as a fish poison; it is a common shrub throughout the whole of East Africa. The natives mash the green shoots with water and throw this into the pond or river; the fish float paralysed on the surface after a few minutes. It was thought that extracts might provide a cheap insecticide especially against mosquito larvæ.

Aqueous extracts of the fresh material had no effect on mosquito larvæ, but seemed to possess some insecticidal effect on adult Diptera. Extracts were then prepared by steeping 50 gm. of young shoots that had been dried in an oven at 100° C. in 100 c.c. kerosene for 48 hours. These extracts gave 100 per cent kill of adult *Glossina* and other Diptera, compared with 20–30 per cent kill given by the untreated kerosene. This recipe was sent to the Industrial Research Board, Nairobi, for further testing; however, it was reported that extracts made there had no appreciable insecticidal properties. The original extracts were then retested at Shinyanga with the same results as recorded above; but when further extracts were prepared from sun-dried shoots of *E. tirucalli*, no appreciable insecticidal properti were found. Owing to pressure of other work th investigation was stopped.

I mentioned these experiments to Mr. Culwic district commissioner, Mahenge, who stated that t African tribes in his district used *Euphorbia calycin* N.E.Br., the common candelabra euphorbia Africa, as an insecticide and claimed that it was ver successful. Further investigation also revealed the Africans used fresh branches of *E. tirucalli* to protec young plants from the ravages of grasshopper slugs, snails and other insects. I witnessed a tes carried out by Mrs. Fairbairn using young shoots *E. tirucalli* laid around various young vegetabl plants. Some plants were left untreated to serv as controls, and these were all devoured, wherea the *Euphorbia* afforded 100 per cent protection fo the others.

I suggest that this subject would be worth furthe investigation.

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Tsetse Research Department,
Tanganyika.

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[1] Mülhens, K., *Deut. Tropenmed. Z.*, 48, No. 3/6, 79 (1944).

Aerial Bactericides

IN an earlier letter[1] we discussed the bactericidal action of lactic acid, mandelic acid and triethanolamine against airborne organisms freshly sprayed from the respiratory tract. Since then we have investigated the aerial disinfectant action of the homologous series of aliphatic α-hydroxy carboxylic acids RR_1C.OH.COOH, including glycollic acid, lactic acid, α-hydroxy valeric acid, α-hydroxy *n*-hexoic acid, α-hydroxy *n*-octoic acid, α-hydroxy *n*-decoic acid, α-hydroxy isobutyric acid, α-hydroxy-α-methyl butyric acid, cyclopentanol-1-carboxylic acid, and cyclohexanol-1-carboxylic acid. We have also investigated the aerial disinfectant action of the mono esters of maleic acid ROOC.CH=CH.COOH, including the methyl, ethyl, allyl, butyl and hexyl esters, and two mono esters of succinic acid, the ethyl and hexyl.

All the compounds which are listed above were effective in destroying the organisms of sprayed saliva (*S. salivarius* and others) and could be of use as aerial disinfectants. Some useful degree of activity may well be expected of other substituted glycollic acids. The effectiveness, as judged by the rate of destruction of bacteria-carrying particles, from a simulated sneeze, reached a maximum for the straight-chain series (R_1=H) at lactic acid. α-Hydroxy *iso*-butyric was the most effective of the disubstituted glycollic acids, being similar to lactic acid in this respect.

The most effective maleic acid ester was the ethyl ester, the maximum killing rate of which was again similar to that of lactic acid. The succinic acid esters appeared less effective than the corresponding maleic acid esters.

Unlike lactic acid and the earlier members of the straight-chain series, the disubstituted acids and the maleic acid esters can be volatilized, without appreciable decomposition, by simple heating. Also the rate of vaporization from relatively large surfaces at room temperatures is sufficient to maintain a useful bactericidal concentration.

Tests of these substances were carried out in an 800 cu. ft. room at temperatures between 60° and 75° F. and over a relative humidity range of 60–75 per cent. The bacteria were sampled on to serum agar plates in a slit sampler[3]. Further details of the actericidal action of these substances nder varying conditions will be published later.

J. E. Lovelock.

ational Institute for Medical Research,
Hampstead, N.W.3.
Nov. 2.

Lovelock, J. E., Lidwell, O. M., and Raymond, W. F., *Nature*, 153, 20 (1944)

Bourdillon, R. B., Lidwell, O. M., and Thomas, J. C., *J. Hyg.*, 41, 197 (1941).

Unit Cell and Space-Group of Co_2Al_9

In an investigation of cobalt-aluminium alloys by X-ray methods, Bradley and Seager[1] identified a phase Co_2Al_9 or Co_3Al_{13}, thus confirming the findings f earlier workers. The composition of the phase appeared to be invariable, but it could not be fixed exactly in the absence of knowledge of the structure. A phase $FeNiAl_9$ (or $FeNi_2Al_{18}$), found in the ternary system of iron, nickel and aluminium, is isomorphous with the cobalt-aluminium phase, and in a paper on aluminium-rich alloys of the ternary system, Bradley and Taylor[2] suggest that this phase is monoclinic. The work described below was carried out in order o test this suggestion.

An alloy containing 32·7 per cent cobalt and 67·3 per cent aluminium was made up in a high-frequency induction furnace under a low pressure of hydrogen. The alloy was annealed *in vacuo* at 900° C. for 48 hours and allowed to cool in the furnace, after which it was found to be brittle and could be easily crushed. Powder photographs were taken, but it was not found possible to interpret these satisfactorily on the basis of a structure with higher symmetry than monoclinic. Interpretation on the basis of a monoclinic unit cell, that is with four unknown quantities, is not practicable. It was therefore decided to try to isolate single crystals of the phase, so that the unit cell could be obtained directly from oscillation and Weissenberg X-ray photographs.

An examination of the crushed fragments under a microscope showed a small percentage of regularly shaped pieces. Some of these were mounted with shellac on glass fibres and photographed in an X-ray camera of 2·8 cm. diameter specially designed to reduce exposure time in these preliminary experiments[3]. The photographs so taken usually contained an irregular distribution of spots, showing that the fragment consisted of a number of crystals, but sometimes traces of layer lines could be detected. From the orientation of these layer lines the crystal could be set with one axis parallel to the axis of oscillation. When this was achieved it was often found that other crystals were also present, giving spots lying between the layer lines. Finally one fragment was found which gave layer lines with no spots between them; this was then known to be a single crystal.

From the single crystal obtained in this manner, the unit cell was found to be monoclinic with $a = 6{\cdot}18 \pm 0{\cdot}02$ kX., $b = 6{\cdot}24 \pm 0{\cdot}02$ kX., $c = 8{\cdot}59 \pm 0{\cdot}02$ kX., $\beta = 95° \pm 0{\cdot}5°$. With these parameters it was possible to index the lines on the powder photograph, thus showing that the fragment selected was of the same phase as the bulk of the material. From the unit cell dimensions combined with density measurements it is found that there are four cobalt and eighteen aluminium atoms per unit cell; the density calculated on this basis is 3·62 gm./c.c., which agrees with the observed density of 3·673 gm./c.c. Thus the composition is represented by the formula Co_2Al_9. The space-group is $P\,2_1/c$ which has four general equivalent positions per unit cell. Hence two of the aluminium atoms must lie on special positions on one of the four sets of centres of symmetry, but it is probable that all the other atoms are in general positions.

Further work on the complete determination of the structure is in progress.

Audrey M. B. Parker.

Cavendish Laboratory,
Cambridge.
Sept. 12.

[1] Bradley, A. J., and Seager, G. C., *J. Inst. Met.*, 64, 81 (1939).

[2] Bradley, A. J., and Taylor, A., *J. Inst. Met.*, 66, 53 (1940).

[3] Parker, A. M. B., *J. Sci. Instruments*, 22, 181 (1945).

A New Test for 2 × 2 Tables

May I reply briefly to some of Prof. R. A. Fisher's remarks[1] on my suggested test[2]?

First, Prof. E. B. Wilson[3] was concerned with tables in which all marginal totals were equal ($m = n = r = s$ in my notation). He calculated the distribution of the difference $(a - b)$ on the assumption that p was given by the column totals to be $\frac{1}{2}$; and his test was based on this distribution. Apart from the facts (a) that my proposal involves neither $m = n$ nor $r = s$, and (b) that my test is not based on the difference $(a - b)$, there is an essential difference of principle between my proposal and that of Prof. Wilson, in that he assumes p to be given by the column totals, while I make no such assumption. My validity condition explicitly covers all possible values of p.

Prof. Fisher's criticism[4] of Prof. Wilson was based primarily on this assumption about the unknown p, and it seems a valid criticism of this assumption; but my proposal is unaffected by it.

Secondly, I wish to emphasize that I do not believe that the conditions stated in my earlier letter for the validity of the test I proposed are *always* satisfied in practice. If they were, there would have been little point in stating them. Conditions can arise where it is altogether false to assume p constant. In such circumstances, we can only try to randomize beforehand; and then, if this is done, Prof. Fisher's test remains valid—a fact not always realized (for example, Wald[5]).

Thirdly, concerning Prof. Fisher's remark that the result where all animals die is irrelevant to the null hypothesis, it may be that this difference of opinion results from a difference of attitude. Suppose we consider two 'null hypotheses': (1) blue-eyed people are just as likely to catch colds as non-blue-eyed people; (2) taking a daily dose of *XYZ* does not affect the chance of having a cold. Each of these hypotheses might be tested by an experiment yielding a 2 × 2 table. But there is a difference of attitude. In case (1), we do not have in mind any proposal to do away with blue-eyed people in order to reduce colds; in case (2) we do have in mind giving people *XYZ*, if it should turn out to be good. In case (1) we *study* the world; in case (2) we propose to *change* it. Our conceptual universe in case (1) is a single fourfold one, in which a given individual can be classified by two distinct attributes—'blue-eyed' and 'cold'. In case (2) we have in mind two distinct two-fold worlds; one possible world, in which everybody has *XYZ* and each individual is classified according to the single attribute 'cold', and another world, in which people go without XYZ and again are classified by 'cold'. In case (2) we wish to decide which of these two possible worlds should be made the real one.

Now suppose all our experimental subjects catch colds. In case (1) we might say we learn nothing. But in case (2) we do learn—in fact it would seem not worth while to give people XYZ, since they seem to catch colds anyway. Of course, the evidence may not be conclusive; but such as it is, it is surely relevant.

Other points will, I hope, become clear in a forthcoming paper.

G. A. Barnard.

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London, S.W.7.

[1] Fisher, R. A., *Nature*, **156**, 388 (1945).
[2] Barnard, G. A., *Nature*, **156**, 177 (1945).
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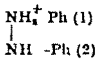
Mechanism of the Benzidine and Related Rearrangements

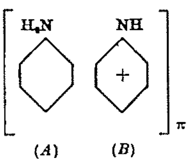
Two electronic theories have been proposed for the benzidine rearrangement[1,2], but both are open to criticism. The present theory is an elaboration of the Robinson[3] mechanism in terms of the quantum theory[4] of aromatic structure.

It is suggested that, in the initial hydrazobenzene salt (I), a non-localized π-electron migrates from ring 2 to ring 1 with consequent fission of the N–N bond to produce the complex molecule (II), composed of the aniline derivative A and the ion-radical B. Since the electron levels of the latter are incompletely filled, and since the π-orbitals of the rings will overlap, exchange forces should hold A and B together. The product will be called a π-complex. The 'π–π' bond in it will be of novel type, joining aromatic systems and not a pair of atoms, but it will be otherwise analogous to the bond in the helium molecule ion He_2^+. Rotation about the bond will be possible, but three positions of stability with intermediate energy-hills will be defined by the alternating polarities round the rings; in them the nitrogens will be opposite each other or 120° apart. The rings in the π-complex will be parallel and co-axial.

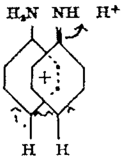


$\begin{array}{l}\mathrm{NH_2^+\ Ph\ (1)}\\ \mid\\ \mathrm{NH\ -Ph\ (2)}\end{array}$

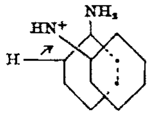
(I)



(II)



(X)



(Y)

If the p-substituents in the π-complex can be eliminated as positive ions, process X will be possible (dotted arrows indicate displacements of single electrons), leading to a benzidine. If reaction is delayed, rotation to a 120° position will allow the formation of a diphenyline by a type X process. Thirdly, process Y, involving a 60° or 180° orientation of the π-complex, will lead to a semidine; this involves a configuration corresponding to an energy-hill and should be less facile than X. If we assun that process X is in fact easier than Y only if involves a p-position of component A, all the dat on the benzidine rearrangement can be interprete in detail.

The products formed will depend not on th 'migratory aptitudes' of the groups but on the poi of attack of the proton catalyst; thus in Y the mo basic ring will function as component A and carr the free amino-group in the product. A diphenylin can form only if the more basic ring has a free *pa* position. These conclusions are confirmed in deta by the existing evidence. Moreover, in naphthalen derivatives, where rotation of the π-complex shoul be inhibited since the rings are not symmetrica diphenylines and p-semidines are in fact neve formed.

Similar π-complex intermediates can be writte for other analogous rearrangements (for exampl N-bromacetanilide, *para* Claisen, Hofmann, etc.)

The theory will be investigated and full details published elsewhere in due course.

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[2] Robinson, *J. Chem. Soc.*, 220 (1941).
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[4] Jacobson, *Ann.*, **428**, 76 (1922).

Properties of Optically Isomeric Mepacrines

In a recent communication, Hammick and Chambers[1] report that whereas the racemic form of the well-known antimalarial drug mepacrine is given to human patients, only the lævo isomer of this drug is excreted in their urine. It seems appropriate to record here that the problem of biological relations of optically isomeric mepacrines has been dealt with in a number of Russian publications during the last few years. After the resolution of racemic mepacrine into its isomers by Chelintsev and Osetrova[2] in 1940, Gause and Alpatov[3] noticed that both isomers of this drug are equally effective against malaria, whereas the dextro isomer is about twice less toxic than the lævo form for mammals and birds. Further, Gause[4] recorded that the dextro isomer differs from the lævo form in the mechanism of its permeability into the living cell. Finally, extensive clinical studies made under the supervision of Prof. Tareev in the clinical department of this Institute confirmed the observations of Gause and Alpatov and showed that the pure dextro form of mepacrine is less toxic for human patients than the usual racemic form, but the strength of antimalarial action in both forms is the same. It is hence clear that the dextro isomer of mepacrine is very interesting from the therapeutic point of view.

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[1] Hammick and Chambers, *Nature*, **155**, 141 (1945).
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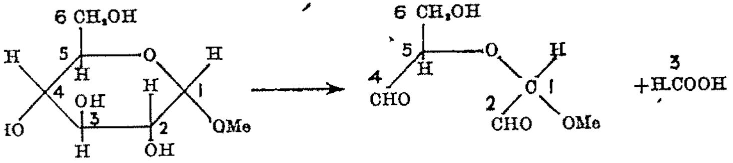
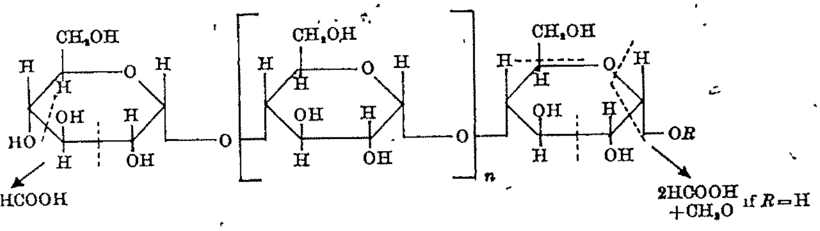
PPLICATION OF NEW METHODS F END-GROUP DETERMINATION TO STRUCTURAL PROBLEMS IN THE POLYSACCHARIDES

By F. BROWN, SONIA DUNSTAN, T. G. ALSALL, PROF. E. L. HIRST, F.R.S., and J. K. N. JONES

The University, Manchester

THE oxidative degradation of α-glycols by periodic acid has found many applications in carbohydrate emistry, one of the most important of these being . S. Hudson's[1] investigation of the reaction between is reagent and the methyl hexopyranosides, which e attacked with disruption of the ring and elimination of the third carbon atom of the hexose as formic cid. In the case of reducing disaccharides consisting f 1 : 4-linked hexopyranose residues, the reducing exose residue should yield a further 2 mol. of formic cid, giving three in all. The corresponding methyl iosides, on the other hand, contain the requisite ystem of contiguous hydroxyl groups only in the erminal residue, and should yield only 1 mol. of ormic acid. It follows that polysaccharides built up n the pattern of starch or cellulose with chains of : 4-linked hexopyranose residues should yield formic cid only from the reducing residues (if any) and from he terminal residues. If, therefore, the reaction ould be carried out quantitatively, an estimation of he formic acid produced would give a measure of he number of end-groups present.





n the other hand, polysaccharides containing : 6-linkages will give rise to 1 mol. of formic acid for every such monose residue which contains no ther substituent. If, therefore, end-group determinations by the periodic acid method and by the methylation method agree, evidence is provided that o 1 : 6-linked sugar residues containing three unsubstituted hydroxyl groups occur in the polysaccharide.

The marked tendency for oxidation of polysaccharides by periodic acid to proceed beyond the stage depicted above[2] has hitherto restricted the usefulness of the method, but the reagent has been used in other ways in the study of polysaccharides. For example, Barry and Dillon[3] showed that by use of periodic acid the stepwise degradation of the : 3-linked polysaccharide laminarin can be effected, and in the case of starch dextrins an attempt has been made to measure the formaldehyde produced from the reducing end of the chain[4].

Our interest in these reactions originated in attempts to gain further insight into the structure of plant gums, suitably bound side-chains of which we hoped to remove with the aid of periodic acid. We at once encountered difficulties due to over-oxidation, and a detailed study of the experimental conditions was undertaken. We have now found that suitable conditions for the quantitative liberation of formic acid from methyl hexopyranosides, methyl biosides of appropriate structure, cellulose, starch, glycogen and certain plant gums, are provided by the use of a solution of sodium periodate to which potassium chloride has been added. Potassium periodate is precipitated, but sufficient remains in solution to effect oxidation under conditions such that the formic acid is liberated quantitatively from the terminal sugar residues in about 180 hr. at 15° C. The concentration of reactants is important and the amount of starting material is so chosen that approximately 7 mgm. of formic acid are liberated per 100 c.c. of solution. The excess of potassium periodate is destroyed by addition of ethylene glycol, and the formic acid is then titrated by 0·01 *N* baryta. Alternatively, the formic acid can be extracted by ether and estimated by the mercuric chloride method or gasometrically from the amount of carbon monoxide produced by the action of sulphuric acid on the sodium salt. The utility and economy of the method are shown by the fact that an end-group determination can be completed in the starch series using as little as 0·5 gm. of material.

Experiments were carried out with the methyl pyranosides of xylose, arabinose, glucose, galactose, mannose, cellobiose and maltose, and also with sucrose, all of which give quantitatively 1 mol. of formic acid. A study was then made of the action of periodic acid on starch and amylopectin. In these materials the proportion of reducing end-groups is small in comparison with the proportion of non-reducing end-groups, and the observed values for the amounts of formic acid liberated can be used to calculate directly the proportion of non-reducing end-groups. It is to be noted, however, that for long straight-chain molecules such as amylose and cellulose, in which both reducing and non-reducing end-groups may be present, formic acid may be liberated from both the first and the last glucose residues, and the calculation must be adjusted accordingly. Nevertheless, for the mixtures of amylose and amylopectin which are present in starches the amount of formic acid given by the long-chain molecules of the amylose portion may be neglected, as a first approximation, in comparison with that given by the many non-reducing end-groups present in the branched chain molecules of amylopectin. The results (see table) have been expressed as the average number of glucose residues in the molecule for every end-group present (estimated experimental error ± 2 units).

In some instances independent end-group determinations were made by the standard methylation procedure. In these experiments the chromatographic method[5] was used for the quantitative separation of the tetramethyl glucose, and it was found to be easily possible to complete an end-group determination using less than 10 gm. of starch.

We then measured by potentiometric titration[6] (using a modification of the standard method kindly placed at our disposal by Mr. R. S. Higginbotham) the iodine-binding power of the various samples. The available evidence, which does not, however, cover the full range of starches, indicates that all amyloses possess similar iodine-binding powers[7], and on this assumption we proceeded to evaluate the amylose contents of the samples (column 2 of table). Since the amylose constituent contributes only negligibly to the formic acid liberated by the action of KIO_4 on starch, the figures in columns 2 and 3 of the table enable a calculation to be made of the chain-length of the repeating unit of the amylopectin portion of the starches. The results (column 5) show that for a wide range of starches the amylopectin component contains approximately twenty glucose residues per end group. Exceptions are the amylopectins of sweet potato (27) and arrowroot (25), but we prefer to postpone discussion of possible causes for these divergences until more is known concerning the iodine-binding power of the corresponding amyloses. Indeed, until further evidence is forthcoming, the possibility cannot be entirely ruled out that materials intermediate in structure between unbranched amylose and much branched amylopectin may yet be encountered. The rice starch examined differed from the previous sample in that for the whole starch there were 24–27 glucose residues per end group in contrast with the earlier figure of 30[8]. The possibility arises that the proportions of amylose and amylopectin may vary considerably for different samples, and this may be true for other starches also; for example, maize, in which widely different amylose contents have been recorded, and waxy maize, for which a higher figure (26) was previously observed[9] for the number of glucose residues per end group. Our present sample of waxy maize starch consisted entirely of amylopectin.

Substance	Amylose content %	Number of glucose residues per end-group		Calculated chain-length of repeating unit of amylopectin fraction
		By KIO_4 method	By methylation method	
Potato starch	18	28	25	23
Crude potato amylopectin	7	21		20
Sago starch	26	24		18
Banana starch	21	27	24	21
Sweet potato starch	18	32	30	27
Arrowroot starch	20	31		25
Tapioca starch	17	25		20
Pearl manioc starch	16	24		20
Rice starch	14	24	27	20
Maize starch	23	25		19
Waxy maize starch	0	20	20	20
Wheat starch	19	26		21

We have applied the method also to various samples of glycogen kindly supplied to us by Dr. D. J. Bell. For all these, the sources being respectively horse muscle, rabbit liver, human muscle, rabbit muscle (fasted), *Mytilus edulis* and *Ascaris lumbricoides*, our results indicated within the limits of experimental error a repeating unit of twelve glucose residues. The same figure was obtained by Bell[10] for horse muscle and rabbit liver glycogen, using the methylation method, and for *Mytilus edulis* glycogen by K. H. Meyer[11] (the others have not yet been examined by the methylation technique). The ne results considerably extend the list of glycogens whic have been found to contain a repeating unit of twelv glucose residues.

For cellulose, after making allowance for the formi acid produced at the reducing end of the chain, a valu of at least 1,000 residues per chain has been obtaine The range of application of the method is furthe shown by the results obtained with: (*a*) inulin[1] (repeating unit approximately 25 fructose residues calculated on the amount of formic acid liberated from the reducing end of the chain); (*b*) gum arabic (our results show that the repeating unit o mol. wt. 1220 found by Smith[13], using the methylatio technique, contains two end-groups which liberat formic acid, support being thus given to the molecula structure for gum arabic advanced by Smith); (*c* ε-galactan of larch wood (there are three end-group per repeating unit of mol. wt. 1104, in agreemen with our previous results[14] and with the formul suggested by White[15]; (*d*) pershore plum gum (th equivalent by acidimetry is 1,200 and the presen results show the presence of one end-group pe equivalent).

Preliminary experiments with other gums an pectic materials have been made and it is apparen from these that special problems arise when the polysaccharide contains terminal uronic acid residu Such substances readily undergo further oxidati with breakdown of the molecule and liberatio additional amounts of formic acid[16]. The pr reason for this behaviour is that after the oxidation is complete there are two >C=O g attached to the $-\overset{|}{\underset{|}{C}}-O-$ ring linkage of the original uronic acid residues. Similar conditions exist whe α-methylmannofuranoside is treated with potassium periodate, the sixth C-atom being removed as form aldehyde, leaving two aldehyde groups attached to the $-\overset{|}{\underset{|}{C}}-O-$ ring linkage. Here also further o tion readily takes place. We have found, fo ample, that zinc borneol glucuronoside and m α-methylgalacturonoside undergo oxidation wi formation of about four equivalents of acid, some of which is oxalic acid. Titrati do not remain constant but begin to fall a 200 hr. owing to the destruction of oxalic the experimental conditions employed.

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MAMMARY CANCER IN MICE

N the introduction to this collection of essays*, Dr.
M. B. Shimkin sketches the historical development
our knowledge of mammary cancer in mice. Dr.
F. Bashford and his colleagues of the Imperial
ncer Research Fund were instrumental in estab-
hing the validity of using animal tumours in
perimental cancer research. Then Leo Loeb and
hers showed the important part played by hormones
mammary cancer. By developing and using inbred
ains of mice, American workers were able to in-
stigate the inheritance of mammary cancer and
veal the existence of extrachromosomal influence.
ie cytology, morphology and histogenesis of the
ammary gland and mammary tumours are dis-
ssed in four illustrated contributions. In general,
ly minor advances have been made in the mor-
ology of mammary tumours since the classical
ork carried out early in the present century. Dr.
. E. Heston reviews our knowledge of the genetics
mammary cancer in mice and describes the origins
d characters of the inbred strains of mice used in
ncer research. This work can be considered to have
mmenced in 1909, when Dr. C. C. Little started
eeding the *dba* strain, although some evidence that
e tendency to mammary cancer was inherited was
ilable before that time.

ie development of knowledge of the milk influence
he genesis of mammary tumours is reviewed by
L. B. Andervont. Early experiments showed
reciprocal matings between strains with high
v mammary tumour-rates, the mice born to
-cancer strain mothers develop cancer, while
iose born to low-cancer strain mothers remain
latively free of tumours. The extra-chromosomal
ctor influencing the incidence was shown by Dr.
J. Bittner, in a series of foster-nursing experiments,
be present in the milk of high-cancer strain mice.
he relative incidence of tumours and the latent
for the appearance of tumours in certain
s of mice vary with the dose of the milk factor,
ie response can be used for the biological assay
factor. The milk factor appears to be a nucleo-
n and is widely distributed in the tissues of
ncer strain mice. As the effect can be trans-
ugh mice without inducing tumours, the
like a latent virus infection. It differs
n viruses in its relatively long latent period.
riments with heterozygous mice showed
aary cancer was generally more common
than in virgin mice, and that the incidence
d by ovariectomy. The importance of
hormones in the incidence of mammary
ld only be clearly shown by treating male
gh-cancer strains which had both chromo-
extra-chromosomal factors for cancer.

tively uniform behaviour of mice from in-
s also makes it possible to study the effects
the incidence and growth of mammary
Dr. H. P. Morris describes many different
in which restriction of food intake or
ias reduced the incidence of cancer or
growth of existing tumours. In their
nstituents and biochemical processes,
tumours resemble other tumours more
an normal breast tissue. Dr. J. P. Greenstein points out that the end results of neoplastic growth are tissues which are chemically similar. The range of activity of several enzymes is much smaller among different tumours than among normal tissues. Mammary tumours in mice have been used extensively for experiments on chemotherapy of cancer, and Dr. Helen H. Dyer, in summarizing and tabulating the work in this field, concludes that no effective remedy has yet been found. Breast tumours in mice form the most valuable material available for such experiments. The probability that the cure for one type of cancer may not work on all types of tumour, however, makes it advisable that more than one type of tumour should be used in therapeutic experiments.

In the concluding essay, Dr. M. B. Shimkin considers the possible implications of the work on mice to human cancer. Whether mammary cancer in women is inherited is not yet known with certainty, so that we cannot say if a milk factor operates in humans or not. Even so, Dr. J. J. Bittner has suggested that it might be desirable to interrupt completely the nursing of daughters in whose family history carcinoma of the breast has occurred.

Mammary tumours in mice have been extensively studied, and the facts which have been obtained are well presented in this symposium. To what extent other tumours, or mammary tumours in other species, resemble these mouse tumours, particularly from the point of view of heredity, remain as interesting problems for the future.

E. BOYLAND.

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ry Tumours in Mice. A Symposium by Members of the
National Cancer Institute, National Institute of Health,
es Public Health Service. Publication No. 22. Pp. v+223.
D.C.: American Association for the Advancement of
.)

STUDIES ON COMPREGNATED WOOD

EXPERIMENTS carried out at the Forest Research Institute, Dehra Dun, indicate that compregnated wood which compares favourably with foreign samples (tests on a foreign specimen of compregnated birch are given) can be produced from Indian timbers. In Indian Forest Leaflet No. 77—1945 (Utilization) entitled "Preliminary Studies on Improved Wood, Part III. Compregnated Wood" (published by Forest Research Institute, Dehra Dun, 1945), it is stated that wood of highly improved properties can be obtained by a suitable combination of impregnation, lamination and compression. In the case of compressed wood and lignostone, whole wood scantlings are used and, by application of great compression, the properties of the material are made uniform in the main direction. In the case of compregnated wood, the timber is sub-divided into veneers, and impregnated with resins, or thin films of glue are placed between the veneers; finally the pack is compressed at a high pressure at a suitable temperature. Alcoholic solutions of resin or film glues, such as Tego film, etc., are used. It is said that, by suitable choice of the species of wood, thickness of the veneers, pressure and temperature employed, and the direction of laying the veneers, the properties of the resulting material can be varied to meet particular requirements. The uses of this material, it is held, are very varied—aeroplane propeller blades are given as an example. The main defects of natural wood in this connexion are low hardness; low cleavage strength; low shear strength and great hygroscopicity. Compregnated wood, on the other hand, has high tensile strength; high shear strength to cope with the high centrifugal stresses at the boss, which at the same time are reduced to a minimum due to the low density of the material in contrast to metal; high damping capacity; favourable strength density ratio; lightness (weight of such blades are a third of metal ones); increases in efficiency (about 6 per cent) by the use of such blades; ease of repair; and finally, it is claimed, freedom from tiring, which is so frequently the cause of fatal air accidents in aeroplanes fitted with metal propellers. Other uses are gear wheels, bearings (ships' tail shafts, rolling mills, textile mills, etc.), fish plates, press forms, gun stocks, electrical machinery and so forth.

For the preparation of compregnated wood in the investigations, rotary cut, sawn or sliced veneers of different Indian timbers were used, some twenty-three species being experimented with. The adhesives employed were tar acid formaldehyde resins prepared in the laboratory, prolamin-formaldehyde dispersions, casein-formaldehyde dispersions or a suitable combination of these materials. The Leaflet, which is illustrated with photographs and tabular diagrammatic statements, discusses the methods and procedure employed in the investigation.

FORTHCOMING EVENTS

Saturday, December 29

Royal Institution (at 21 Albemarle Street, London, W 1), at 2.30 p.m.—Sir Robert Watson-Watt, F.R.S "Wireless" (Christmas Lectures adapted to a Juvenile Auditory, 2)

Tuesday, January 1

Royal Institution (at 21 Albemarle Street, London, W.1), at 2.30 p m.—Sir Robert Watson-Watt, F.R.S.: "Wireless" (Christmas Lectures adapted to a Juvenile Auditory, 3)

Television Society (at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2), at 6 p.m.—Mr. F. A. Inskip: "A Test Signal Generator for Television Receivers"; Mr. A. M. Spooner: "Cathode Ray Tube Quality Measuring Apparatus"

Wednesday, January 2

Royal Society of Arts (at John Adam Street, Adelphi, London, W C.2), at 2.30 p m.—Dr C. B Williams "The Migration of Butterflies" (Dr. Mann Juvenile Lectures, 1).

Thursday, January 3

Royal Institution (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Sir Robert Watson-Watt, F.R.S.: "Wireless" (Christmas Lectures adapted to a Juvenile Auditory, 4).

Royal College of Surgeons of England (at Lincoln's Inn Fields, London, W C.2), at 5 p.m.—Mr. N. L. Capener: "Physiological Rest—the Orthopædic Principle".

Association for Scientific Photography (in the Theatre of the British Council, 3 Hanover Street, London, W.1), at 6.15 p m.—Dr. A J. Holland: "Glass and Photography"

Friday, January 4

British Ecological Society (in the Washington Singer Laboratories, Prince of Wales Road, Exeter), at 10 a.m.—Annual General Meeting.

Institute of Physics, Electronics Group (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 5.30 p.m—Prof. N Feather, F.R.S.: "Artificial Radioactivity".

Saturday, January 5

Royal Institution (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Sir Robert Watson-Watt, F.R.S. "Wireless" (Christmas Lectures adapted to a Juvenile Auditory, 5).

Monday, December 31—Saturday, January 5

Twenty-ninth Annual Conference of Educational Associations (at King's College, Strand, London, W.C.2).

Wednesday, January 2

At 5 p.m. (in the Great Hall).—Lady Simon: "The School, the Teacher and the Home" (Presidential Address).

Thursday, January 3

At 2.30 p.m. (in the Great Hall).—Discussion on "The Teacher's Profession" (to be opened by Mrs. M. D. Stocks and Mr. Nigel O. Parry).

APPOINTMENTS VACANT

Applications are invited for the following appointments on before the dates mentioned

Assistant Bursar—The Bursar, Queen's University, Belf (January 10).

Principal—The Clerk and Treasurer, Dundee Institute of Art a Technology, Bell Street, Dundee (January 12).

Patent Agent (qualified), preferably holding an Engineer Degree or equivalent qualification, by a large Engineering Compa electrical and mechanical—The Ministry of Labour and Natio Service, Appointments Department, Technical and Scientific Regist Room 572, York House, Kingsway, London, W.C.2, quoting F.5222 (January 12).

Deputy Borough Engineer and Surveyor—The Town Cle Town Hall, St. Marylebone, London, W.1, endorsed 'Deputy Borou Engineer and Surveyor' (January 12).

Lecturer in Hausa—The Director, School of Oriental and Afric Studies, University of London, London, W.C.1 (January 15).

Archæologist (man or woman)—The Keeper of the Museum Yorkshire Museum, York (January 31).

Professor of Chemistry—The Principal, Heriot-Watt Colle Edinburgh (April 22)

Professorship of Industrial Chemistry at Istanbul Univers —The British Council (Appointments Department), 3 Hanover Stre London, W 1

Bacteriologist to work on the intestinal flora, a Biochemi with good bacteriological knowledge for microbiological assay of t vitamins, and an Organic or Bio-Chemist for other work involvi vitamin assay—The Secretary, National Institute for Research Dairying, Shinfield, Reading.

Chemists (male), Inter. B.Sc. standard, as Assistant Works Chemi with large firm of cement manufacturers—The Ministry of Labour a National Service, London Appointments Office, 1–6 Tavistock Squa London, W C 1, quoting Ref. No. C.N.68

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(not included in the monthly Books Supplement)

Great Britain and Ireland

Radar: a Report on Science at War. Released by the Joint Bo on Scientific Information Policy for Office of Scientific Research a Development, War Department, Navy Department. Pp. 50. (London: H.M. Stationery Office; Washington, D.C.: Governmen Printing Office, 1945.) 1*s.* net. [25

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West India Royal Commission Report. (Cmd. 6607.) Pp. 480+16 plates (London: H.M. Stationery Office, 1945.) net.

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Contributions from the United States National Herbari 29, Part 2 Mexican Phanerogams described by M. E. J C. V. Morton; Asteraceae described from Mexico and th western United States by M. E. Jones, 1908–1935, by S Pp. xi+87–138. (Washington, D.C.: Government Printi 1945.) 20 cents.

Proceedings of the United States National Museum. V 3193: The Ichneumon-Flies of the Genus *Cryptanura* Bru Tropical American. By R. A. Cushman. Pp. 139–176. V 3194: Neotropical Lanternflies of the Genus *Phrictus* in States National Museum, with Descriptions of Four New John S. Caldwell. Pp. 177–184. (Washington, D.C.: G Printing Office, 1945.)

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American Philosophical Society. Year Book 1944, Janua December 31, 1944. Pp. 394. (Philadelphia: American Pl Society, 1945.)

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High Vacuum for Industry. Pp. 30. (Boston, Mass.: Research Corporation, 1945.)

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Libros de medicina, farmacia y veterinaria. Pp. 64. Libreria Casas y Buendia, 1945.)